Concrete

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Untechnical Technicalities

NOT infrequently requests come to this magazine that we undertake to put the reader on a short and direct road to wisdom in matters of concrete design. We are asked to do it in words of one syllable and in simple arithmetic—so that a man with no engineering training whatever can solve problems instanter on the job—problems that other men have spent a good many years of technical training at learning to solve. It's too much. It can't *always* be done.

A good many engineering problems, that the technically trained man, from force of habit, thinks of in terms that nobody but a technically trained man can understand, will by persistent effort yield to simplification. While the technical man is wedded to his jargon, some even complex technical statements come down to more or less every-day English. We have noted sometimes that the most highly trained men, technically, are the easiest understood.

This magazine makes a consistent effort to give the greatest possible technical information in the least technical way, but when it comes to such matters as reinforced concrete design there is a barrier beyond which it is humanly impossible to go.

That "there is nothing new under the sun" applies to the concrete construction field the same as to others. It might be argued that each so-called new idea in concrete design is merely the adaptation of established principles to cases a little out of the ordinary, or applying the principles in a little different way.

There are many fundamental ideas pertaining to design with which every concrete man is more or less familiar, but which need to be clothed in a new garb—told in a little different way—that they may be better remembered and consequently more properly used. But an understanding of them goes back to fundamentals for a complete knowledge of which there is no easy road.

There is considerable demand for information, voiced by an increasing number who are interested most in the fundamental principles involved and in safe construction.

While it is practically impossible to explain some even simple principles of design without using technical terms, more information is gradually becoming available as to the "hows" without telling the "whys."

It should be remembered that in merely following simple rules as to how a thing is to be done, numerous factors have to be ignored or taken for granted. The only factors that should be taken for granted are the fundamentals that have been proved and accepted.

* * *

Two things are here in mind as expressing the viewpoint of this magazine toward its readers:

Let the technical man try to make himself understood.

Let the untechnical man realize without impatience that complex engineering can't always be stated in simple arithmetical terms.

Between these two thoughts this magazine is published with the idea that the greater number of its readers would rather know *how* than *why*—if they can't know both.

Cement Trial Jury Disagrees

Government Announces Case Will Be Retried Promptly

See Major Edwin C. Eckel's Article Page 259

Uniting the Construction Industry

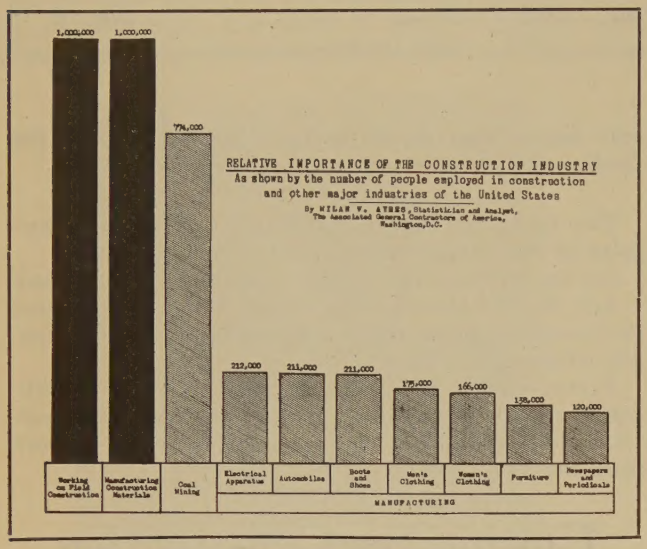
FOR the first time in American industrial history, the great construction industry has united in all its elements—manufacturers, dealers, labor, and the professional branches—in an effort to raise the standards and efficiency of the industry and improve the service which it renders the public. The American Construction Council, the organization details of which are being settled, will bring together for conference, for betterment of understanding and for common action all the elements concerned with building work of any description. Secretary of Commerce Hoover will preside at the first organizing meeting, in Washington, D. C., June 19 and 20, and Franklin D. Roosevelt, of New York, former Assistant Secretary of the Navy, has agreed to accept the presidency of the organization. An idea of the extent of the construction industry can be gained from an inspection of the illustration. It relation to the scheme of things can be gained from this and the fact that construction reports have become the equal of crop reports as barometric indicators of the material prosperity of the country.

Nearly 250 national organizations which have learned of their large amount of duplicate effort and their inability to cope with such broad situations as the housing shortage and the public distrust of building prices, feel the new organization comes at the right time.

Its aims will be, at first, to establish a code of ethics that will be universally accepted in the industry, to collect statistics that the industry needs for its intelligent operation; to provide for the shortage of building trades' mechanics by a proper system of apprenticeship; to give publicity to and encourage the adoption of the new na-

tional building code now being formulated under the direction of Herbert Hoover.

In addition, the program of immediate work embraces transportation, encouragement of local building shows, publicity directed at giving the public an adequate conception of the magnitude and work of the construction industry, and studies of seasonal employment, with the initiation of efforts to level out the seasonal swings.



In its organization the cardinal feature of the Council lies in giving each group equal voting power. The ten groups agreed upon are: Architects, engineers, construction labor, general contractors, sub-contractors, materials and equipment manufacturers, materials and equipment dealers; bond, insurance and real estate interests; construction departments of public utilities, and the construction departments of federal, state, and municipal governments. Some of the associations engaged in the organization work have been the American Institute of Architects, the Federated American Engineering Societies, the Building Trades Department of the American Federation of Labor, the Associated General Contractors, the National Federation of Constructive Industries, the National Building Congress, the National Association of Building Exchanges, the Building Trades Employers' Asociation, the National Real Estate Board, besides a large number of associations of manufacturers.

Tests to determine the value of anchoring reinforcing bars in concrete structural members have been interpreted as showing that a semi-circular hook of four times the diameter of the bar and well embedded in concrete may be assumed to develop the elastic limit of the steel without exceeding the bearing strength of the concrete. The bars should be bent to 180 degrees with a short length of straight rod beyond the bend. In other words, the 180 degree bend is sufficient to anchor the end of the bar so that the full strength of the bar can be developed without the concrete, about which the rod is hooked, becoming crushed.

On a recent excavation job, where motor dump-trucks were loaded by a steam shovel with large, jagged boulders which were bunted into place by the shovel, rails were laid on the bottom of the truck to protect the body from this severe punishment and incidentally make the work of packing the truck easier.—*Successful Methods.*

An appeal to the Children of our Subscribers, *from* Jessy and Heddy Salzwedel Riga, Latvia

Heddy and Jessy Salzwedel are two little Russian girls out of Ten Million little children over there who haven't enough to eat.

Their father, R. A. Salzwedel, is an engineer who has practised his profession in America and who has been down in the valley for eight years and here is his story:

Salzwedel was located in Riga in 1914. He was a subscriber to American engineering magazines, and had collected a small library of American technical books.

He joined the colors and fought for the Allies. With each new advance of the enemy into Russia, CONCRETE received a change of address from Salzwedel. He kept his family together, fought, suffered and moved back inland.

Peace brought no relief to him. He sold his files of American periodicals, sold his books one by one, parted with his instruments. He gathered his family again in Riga, which is in Latvia, and recalling a credit he had on our books, wrote for the money. "Send it in American check," he writes; "each dollar will keep the four of us for two days."

Money is going forward to Salzwedel and his wife and Heddy and Jessy, and if any subscriber to this magazine has a little girl and that little girl wants to send some of her ice cream money to Heddy and Jessy, to buy them bread, we shall be happy to see that the money reaches them.

Make checks or money orders payable to CONCRETE. All funds will be sent forward to the Salzwedels July 25. An acknowledgment will be asked from Heddy and Jessy.

If any of the children wish to write letters to the Russian girls, CONCRETE will forward the letters. The little girls do not read English, but their father can read the letters to them.

This appeal is written without the knowledge or consent of Mr. Salzwedel, but we are sure that any help received from his American brothers will be most welcome. Address all letters and remittances to CONCRETE, 1807 East Grand Boulevard, Detroit, Mich.

The Concrete Pile[1]

Its Development—Types and Advantages

By George P. Morrill
District Manager Raymond Concrete Pile Co.

The history of the concrete pile industry, though covering a comparatively short period of time, is a voluminous one. Many interesting experiments, chiefly along the line of precast work, were made in the early days of the industry, but many of these types are now obsolete. This discussion is confined to those types of concrete piles now in use.

The introduction of the concrete pile is the result of cheap cement. Had we not been able to secure cheap and reliable cement in the necessary quantities, the cost would have been prohibitive. As wooden piles had been in general use for centuries, the idea at first was, naturally, to make concrete piles which could be handled and driven in the same manner as the wooden ones. This necessitated their being cast in forms on the ground surface with sufficient reinforcement to withstand the stresses due to handling and driving. Concrete piles, made by the precast method, were first used in Europe, and up to the present time the vast majority of concrete piles used there have been of the precast type. In America, however, two distinct types have been evolved: the precast and the cast in place.

Advantages of Concrete Over Wood Pile

Wood will not rot if it is continually submerged in water. When the world-famous Campanile of Venice fell in 1902, the wooden piles which had been placed in its foundation, one thousand years before, were found to be in perfect condition and were used to support the reconstructed tower. There is, therefore, no doubt as to the durability of wooden piles when constantly submerged, and for such kind of construction as bridge piers it will generally be found that they furnish the cheapest and most feasible type of foundation. It is another story, however, when we consider the foundations for buildings, or for works where the piling is subjected to alternate wetting and drying, as in wharves, docks, etc. In the case of a building foundation, the permanent ground water level must be determined and the heads of the piles kept below it. This practice would be all right if one could be assured that the ground water level would remain permanent. It often happens, however, especially in growing cities, that subsequent construction of subways, sewers, etc., so lowers the ground water level that the piling under previously built structures is seriously damaged and difficult and expensive repairs are necessitated. Another difficulty in connection with wooden piling is the impossibility of determining the condition of the pile after it is driven. Unless great care is taken in driving, and an experienced man is in charge, the bearing capacity of the pile as determined by a pile formula may be satisfactory but the pile may be overdriven.

Furthermore, the bearing capacity of the wood pile is only one-third to one-half that of a concrete pile, due to the larger size of the concrete pile and its ability to withstand much greater punishment in driving.

The advantages of concrete piles over wood piles may then be summarized as follows:

First—Independence of the ground water level. Concrete piles may be cut off at any level, thus effecting great savings in excavation, sheeting, shoring, pumping, footing concrete, etc.

Second—The structural integrity of the pile is assured, provided a proper type of construction is employed.

Third—A bearing capacity two to three times greater, thus reducing the area of footings and effecting a further saving of footing concrete.

Precast Piles

Concrete piles, as previously stated, may be divided into two types: the precast and the cast in place. By precast piles we mean those which are cast in forms on the ground surface, and in which is embedded sufficient steel reinforcement to withstand the stresses caused by handling and driving. They were first used by Hennibique in France in 1896, and later on various patented types, such as the Chenoweth, Cummings, Giant, etc., were developed in this country. Few, if any, of these patented types are in use today. The great majority of precast piles are built with a square or rectangular cross section, with chamfered corners to prevent chipping and spalling in handling, although piles of hexagonal or octagonal cross section are sometimes used. They are usually 12 in. to 24 in. in diameter, according to load and length. Some notable exceptions of long precast piles are:

Terminal Pier, Halifax	77 ft.
Gulf Refining Co. Wharf, Philadelphia	82 ft.
Pier, Havana	85 ft.
Wharf, Auckland, New Zealand	10[illegible] ft.
Pier, San Francisco	106 ft.

Most of these piles were designed to carry a load of 40 tons each, and were about 20 in. square.

In recent years the use of precast piles in the construction of wharves, piers, bulkheads, etc., has been steadily growing in favor. The durability and much greater bearing capacity of this type of pile as compared with the wood pile, give it a very decided advantage. It is true that some engineers believe it to be poor practice to place concrete in sea water where it will be exposed at low tide.

The disintegration of concrete in sea water is caused by two things: frost action and chemical action. By frost action is meant the penetration of water into the surface of the concrete, subsequent freezing, and spalling off. In order that frost action may take place it is necessary that the concrete should be porous. Experience has shown that by careful grading of the aggregates and using a concrete rich in cement and of high strength, and thoroughly curing the piles before driving, a practically impervious concrete can be produced and

[1]Abstracted from a paper read before the Providence Society of Civil Engineers.

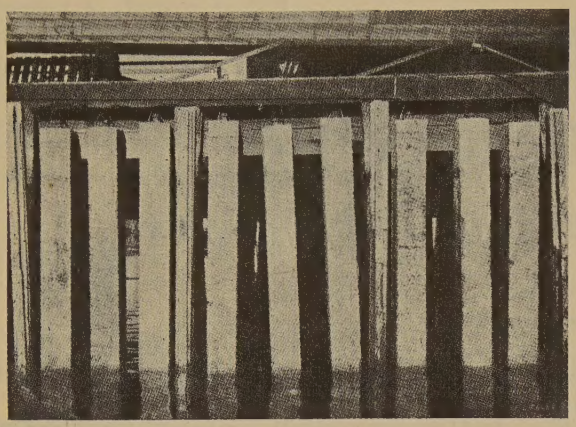


FIG. 1—VIEW SHOWING NINE OF THE PIERS AT ALMOST LOW TIDE
Courtesy Aberthaw Const. Co., Boston, Mass.

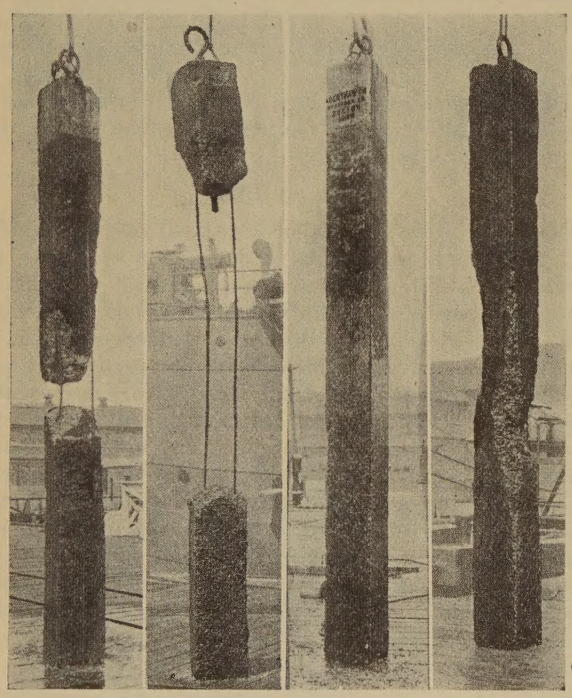


FIG. 2—SAMPLE NO. 7 IN 1913 AND IN 1920, PROPORTIONS 1 CEMENT, 3 SAND, 6 STONE—CAST QUITE DRY—(RIGHT) SAMPLE NO. 13, IN 1913 AND IN 1920, PROPORTIONS 1 CEMENT, 3 SAND, 6 STONE—CAST WET
Courtesy Aberthaw Construction Co.

frost action entirely prevented. It would be extremely unwise to use any kind of concrete, other than precast, between the limits of low and high tides, and great care should be taken to see that all precast work has been thoroughly cured before it is placed in contact with salt water.

Concerning the other cause of disintegration, chemical action, little is definitely known, but it is supposed to be due to magnesium sulphates and chlorides and calcium chlorides in the sea water. Modern portland cement is highly resistant to the action of sea water, and when the concrete is made of the best and most suitable materials, combined in the proper proportions, there is little or no danger of chemical action.

In January, 1909, the Aberthaw Const. Co. cast a number of concrete specimens which were hung under the cap log of a wharf at the Navy Yard, Charlestown, Mass., in such a manner that the lower end of the specimen was always immersed at low tide, and the upper end was always above high tide, thus exposing it to alternate freezing and thawing in cold weather. These specimens were carefully examined in 1911 and 1913, and, lastly, in June, 1920, nearly 11½ years from the time they were originally placed.

The specimens made of lean concrete (1:3:6 specimens) showed considerable deterioration. This deterioration was undoubtedly the result of frost action on the porous concrete. However, those made of a rich, hence, an impervious concrete, showed no deterioration. Magnesium sulphate attacks alumina, so one would suppose that a concrete made of cement high in alumina would be a bad one to use in sea water. Of the specimens shown, the cement used in No. 16 was free from alumina, No. 14 was low, No. 3 average, and No. 18 was high in alumina content. However, it is plain that no deterioration has taken place after 11½ years of exposure.

SHEET PILING

In recent years precast concrete sheet piling has been developed and largely used. These are made in the same way as other precast piles but have a tongue and groove joint and have been generally used in the construction of bulkheads and seawalls. They are driven in the same way as wooden sheet piling and a concrete cap placed from which reinforced concrete beams extend back to suitable anchorages buried in the ground. This type of construction, rendering unnecessary the use of cofferdams and caissons, and reducing greatly the volume of excavation and concrete, will, in most cases, offer considerable savings in cost and time of construction as compared with the conventional types.

The reinforcement of precast piling should be as simple as possible, in order to minimize the difficulty of securing an impervious concrete and the minimum dis-

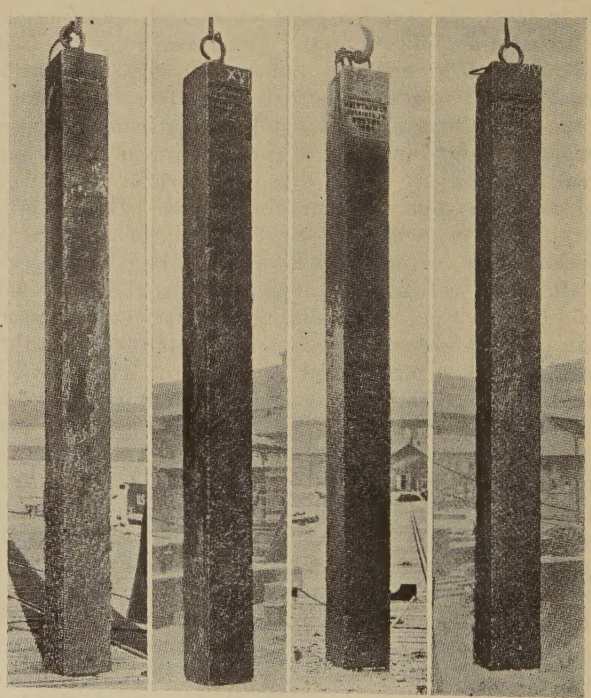


FIG. 3—SAMPLE NO. 16, IN 1913 AND IN 1920, PROPORTIONS 1 IRON ORE CEMENT, 1 SAND, 2 STONE—CAST WET—(RIGHT) SAMPLE NO. 14, IN 1913 AND IN 1920, PROPORTIONS 1 HELDERBERG & LEHIGH CEMENT MIXED, 1 SAND, 1 STONE—CAST WET
Courtesy Aberthaw Construction Co.

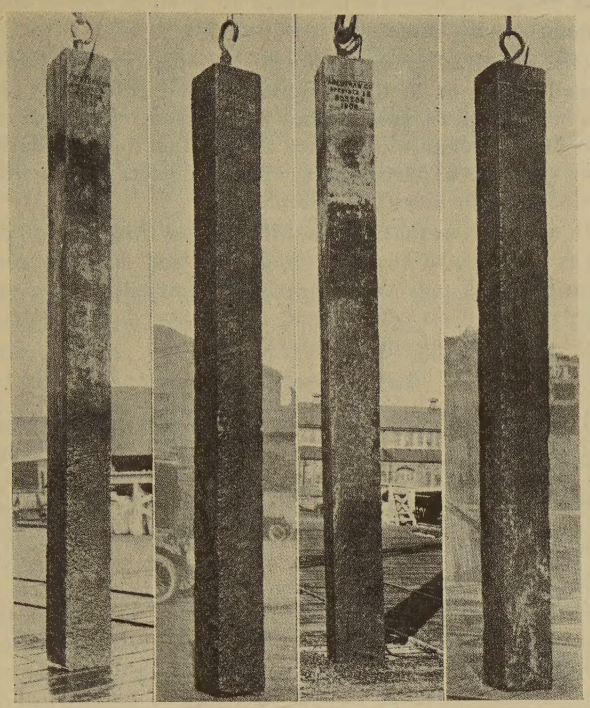


FIG. 4—SAMPLE NO. 3, IN 1913 AND IN 1920, PROPORTIONS 1 CEMENT, 1 SAND, 2 STONE—CAST VERY WET—(RIGHT) SAMPLE NO. 18, IN 1913 AND IN 1920, PROPORTIONS 1 UNIVERSAL CEMENT, 1 SAND, 2 STONE—CAST WET
Courtesy Aberthaw Construction Co.

tance from the pile surface to the reinforcement at any point should be two inches.

CAST IN PLACE

Cast in place piles are, in this country, much more widely used than precast ones, owing to their lower cost with equal, or, in some cases, greater reliability. Cast in place piles, which are essentially foundation or weight carrying piles, may be divided into two classes:

(1) The pile which is formed by driving a collapsible steel mandrel, encased in reinforced steel shell, into the ground until sufficient penetration is secured, then withdrawing the mandrel, leaving the shell in the ground to serve as a form which is filled with plastic concrete. This is known as the Raymond system, and is the one followed by the Raymond Concrete Pile Co.

(2) The pile, which is formed by driving a pile having a cap or protective point, into the ground until sufficient penetration has been secured, filling the pipe with plastic concrete and then withdrawing the pipe in such a manner that the concrete will fill the hole left by the withdrawal. For convenience of comparison with the Raymond system, we may refer to this as the *formless* system, as it has no protective form for the concrete left in the ground.

All types of cast in place piling generally used in this country are based on these two principles.

As previously stated, the great majority of concrete piles used in Europe are of the precast type, but two types of cast in place piles, the Compressol and the Wilhelmi, have been developed there and used to some extent. They are both of French origin.

The Compressol pile is formed by raising a conical shaped weight about two and one-half tons, with its point downward and dropping it so as to penetrate the ground at the desired location. Successive blows of the weight eventually create a cavity extending to the desired depth, or bearing stratum. If the ground is water bearing, clay and cinders are dumped into the cavity and rammed by the succeeding blows into the surrounding soil, so as to render it impervious. When the desired depth is reached, concrete is deposited in the cavity and, by means of a somewhat more rounded tool weighing approximately two tons, expanded laterally into the surrounding soil, thus giving a spread to the footing. The concrete in the upper part of the cavity is tamped by a weight having a flat bearing surface, and this process is continued until the cavity is completely filled.

The Wilhelmi pile closely resembles the pedestal pile in final result, except that the bulb chamber is formed by exploding a charge of dynamite in the lower portion after the tube has been driven. Both of these piles are practically unknown in this country, and, to my knowledge, there is only one instance where they have been used here. This was in New Jersey, in 1913, where a foundation was put in by the Compressol method.

DEVELOPMENT OF CAST-IN-PLACE PILING IN THE U. S.

The Raymond system was the first to be developed and patented in this country. The inventor, Alfred A. Raymond, was a bridge builder and practical pile driving man who, in the course of his practice, had occasion to note and to be impressed by the short life of timber piles used in the construction of trestles. It was in an attempt to secure a substructure permanency equivalent to that of masonry superstructure, that he devised the Raymond system of concrete piling.

Piles of this type were first driven by Mr. Raymond in the foundation of the Bryson Apartment Bldg., Chicago, in 1901. Three hundred fifty Raymond piles were used and this was the first building in the United States to be founded on cast in place concrete piles.

The *formless* system was devised in 1903, and has been somewhat modified in later years. The general method of the *formless* system is as follows: A pipe 16 in. in diameter and closed at its lower end by a loose cast steel point, is driven to the required penetration. The pipe is then partially filled with concrete and afterwards partly withdrawn, leaving the cast steel point to serve as the base of the pile. Alternate fillings and withdrawals of the pipe take place until it is completely withdrawn, and the hole originally made by the pipe is supposedly filled with green concrete.

The method of driving the so-called pedestal pile is practically the same as that just described, except that in driving the 16 in. pipe contains a core which projects several feet below its end. The theory is that penetration is secured to a suitable stratum upon which the core rests. The core is then removed and the pedestal, or enlargement at the base of the pile, is formed by ramming concrete into the cavity left by the removal of the projecting core. After the pedestal has been formed, the method of filling and withdrawing the pipe is similar to that just described.

While the theory of this type of piling sounds all right, and has doubtless given excellent results in some cases, a careful inspection of established facts would seem to indicate that the field within which it may be advantageously employed is of narrow limits. Its principal advantage is that its cost is naturally lower than a type which leaves a protecting form for the concrete in the ground.

Some of its disadvantages may be summed up as follows:

(1). Most piles, for the major part of their bearing capacity, rely on the friction developed between the surface of the pile and the soil through which it is driven. When the pipe is withdrawn this frictional value is lost and no reliance can be placed on bearing capacity as in-

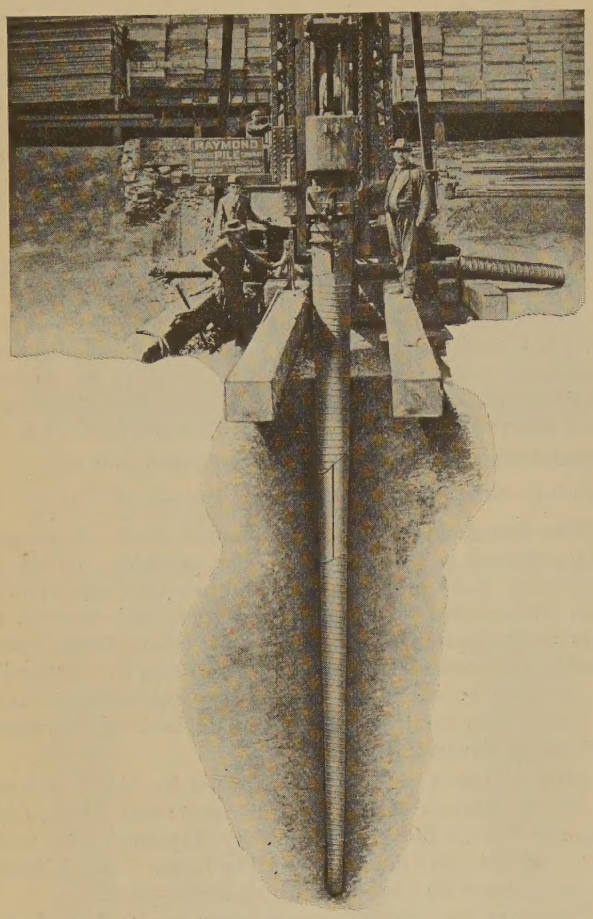


FIG. 5—RAYMOND RIG—TAPERED RAYMOND PILE AND SPIRALLY REINFORCED SHELL ALSO SHOWN

dicated by pile driving formulae such as the *Engineering News* formula; thus necessitating expensive load tests.

(2). They cannot be used in semi-fluid material, or in places where part of the length is constructed in water, as the concrete would escape laterally when the pipe is withdrawn.

(3). It often happens that, in withdrawing the pipe, arching of the concrete filling takes place, allowing the surrounding soil to fill the space where the concrete should be, thereby causing a greatly reduced section, or, in some cases, separating the pile in short segments with layers of earth between. As there is no way of inspecting the pile after the pipe is withdrawn, except by digging it up, there necessarily exists great uncertainty as to its structural integrity.

(4). If the soil is at all dry and porous, a large portion of the water from the green concrete must be absorbed, thereby greatly impairing its strength.

(5). If the soil is only partially compressible, as most soils are, very great lateral pressures are caused by driving piles closely together, as is necessary in, say, a pier foundation. You can readily imagine what often occurs in such a case when the pipe is withdrawn and immediately driven again alongside the pile just driven, whose concrete, still green, must withstand these enormous lateral pressures. Of course, the concrete is displaced and the pile ruined. That this displacement frequently occurs has often been proven by subsequent excavation.

The results of experiments seem to indicate that pressures set up in the soil by driving, remain active for at least 24 hours after the pile is driven, and it is evident that the green concrete is immediately subjected to these pressures with disastrous results.

(6). Rate of progress by the *formless* system is necessarily slow, as each pile must be filled before the pipe can be withdrawn and another pile driven. On construction of any magnitude, speed in placing the foundation is of supreme importance, as all other parts of the work are obliged to await its completion.

It would seem that the useful field for this type of piling is confined to locations where the soil is easily compressible and non-water bearing; where the piles are widely spaced on centers and where speed in construction is a factor of small importance.

THE RAYMOND SYSTEM

The chief difference in principle between the *formless* and Raymond system lies in the fact that in the former the green concrete is immediately exposed to disruptive pressures from the driving of adjacent piles, absorption of water from the concrete and reduction of section by the arching of the concrete when the pipe is withdrawn, while in the latter, the concrete is deposited in a reinforced steel sheel or form, which is left in the ground and protects the concrete while setting against external pressures, etc., until it has thoroughly hardened. Also, in the *formless* system the pile is cylindrical or straight sided, while in the Raymond system the pile is tapered. About 80% of the cast-in-place concrete piles used in this country are constructed on the Raymond system, and the steel shell or form has been one of the chief factors in the success of the system.

In the early days of the Raymond system the shells were made on the job of plain sheet steel of various gauges, tapered to fit the collapsible mandrel. It was found, however, that although 20 gauge steel would successfully resist the pressure in some soils, 14 or even 12 gauge were required in other soils. Furthermore, it seemed impossible to predetermine just what pressure might be encountered, and this fact made it difficult to estimate the cost of shells for any specific contract. After considerable experimentation, the spirally reinforced shell now used was introduced and has successfully overcome the aforementioned difficulties.

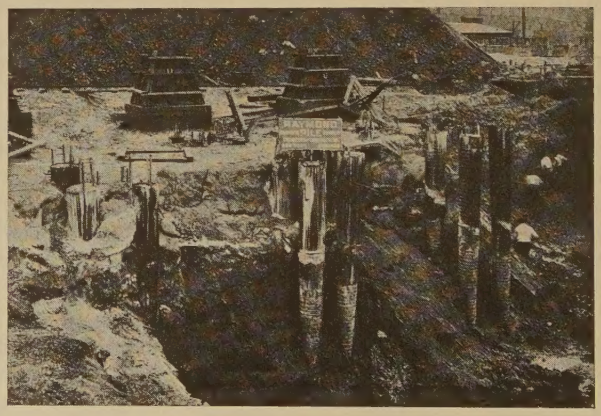


FIG. 6—RAYMOND PILES AS REVEALED BY CHANCE EXCAVATION—EVERY PILE FOUND TO BE A PERFECT PILE

The number of piles driven by one machine in one day will naturally vary according to job conditions, pile spacing, etc., but it is usually safe to estimate an average of 25 to 30. Of course, this average is very often exceeded and sometimes not attained. The greatest num-

ber of concrete piles ever driven by one machine in one day, 140, were driven by the Raymond Co. in Youngstown, Ohio, in September, 1917. Of course, the conditions were especially favorable.

It sometimes happens, owing to change of plan, or in the course of an experiment, that driven piles are excavated, and wherever Raymond piles, which have been placed under their specifications, have been exposed they have shown a conditions as illustrated in Fig. 6.

Taper

A pile carries its load partly by friction with the ground throughout its entire length, and partly as a supported column with its lower portion driven firmly into underlying stable soil, or upon the rock. It is often the case, however, that the soil is of the same nature to any practical limit of depth, and it becomes merely a question of developing a frictional bearing to sustain the required load. In friction soils tapered piles afford a better carrying capacity than straight piles do.

This is a very important feature, the merits of which should not be overlooked. The tip of the Raymond pile is 8 in. in diameter, the diameter increasing four-tenths of an inch for each increase of one foot in length. The taper, therefore, is one in 60, and a pile 30 ft. long has a diameter of 20 in. at the top.

This extreme taper offers maximum resistance for a given length. Of course, under certain conditions, straight piles can be used to advantage, but in the great majority of cases, the tapered pile has proven the more effective.

The cost of many concrete pile foundations has been increased by failure to appreciate the greater carrying capacity of a tapered pile, for the reason that contracts are often awarded solely on the basis of the lowest price per linear foot. The price per foot of either wood or concrete piles is, in a measure, inersely proportional to the number of feet in the contract. It is quite conceivable that tapered piles loaded to 30 tons each might average 20 ft. in length, while straight piles loaded to 30 tons might average 30 ft. In that case, the economical price of the straight pile should not exceed 67% of the tapered pile price.

It should also be remembered that Raymond piles can be placed on closer centers than piles of the *formless* type, resulting in a material saving in cost of footings, reinforcement and excavation.

In the comparatively rare instances where piles act solely as columns, the Raymond company places a variation of the standard pile, which is much thicker and has a large point bearing area. This is known as the stub pile.

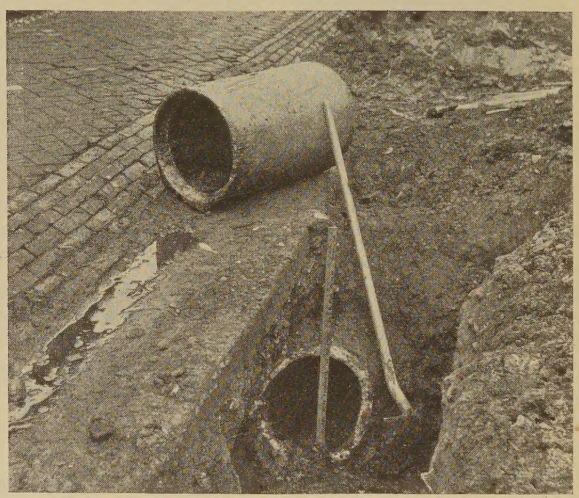
In the majority of cases Raymond piles are driven to carry a load of 30 tons each. In some cases, where proper soil resistance cannot be secured, they are loaded to 25 tons, or, in extreme instances, to 20 tons. In other cases loads of 35 and 40 tons are safely carried.

Composite Piles

In recent years the Raymond company has developed a combination wood and concrete pile known as the composite pile. This is used in localities where the soil is of such a quality that piles of extreme length are needed, and where the permanent ground water level is from, say, 10 to 20 ft. below the ground surface. A wood pile is driven to a sufficient depth below the water level, thus preventing any deterioration, and a concrete pile superimposed from the water level to the ground level. This pile combines the cheapness of the wood pile with the durability of the concrete, and has been used to a considerable extent in various localities of the Middle West and South. They have never been placed in New England, as the company has never encountered conditions there which would warrant their use. They have shown up very well under test, having sustained loads of from 40 to 60 tons with slight settlement. In practice, however, they are not usually loaded to more than 20 tons.

In determining the safe load for either wood or concrete piles, it is customary to use the *Engineering News* formula. It has been the experience of the Raymond company that the application of this formula to carefully recorded observations of the actual driving constitutes a method of measuring bearing capacity with practically as much certainty as testing the pile with an actual load. Furthermore, each particular pile is in actual practice subjected to this test, so that definitely known bearing values are established at each point where loads are concentrated.

It sometimes happens, however, that, owing to building code stipulations or other reasons, actual load tests are required. These tests are usually made with the material most conveniently at hand.



Concrete Sewer Pipe Dug Up After 47 Years' Service

Concrete Sewer Pipe of 1874 Dug Up

A concrete sewer pipe, laid in Madison street, Kokomo, Ind., in 1874, was dug up March 22, 1922, and found to be in perfect condition, in spite of its 47 years' use. Until last fall, when it was abandoned on account of its size and location, it had been in constant service as a sanitary sewer.

The pipe, 15 in. in diameter and about 36 in. long, was 3 ft. in the ground. It was made with one flat side and laid on a plank. It was necessary to break off a small projection on one end of the tile in order to lift it out. An examination of the break showed that the small stones embedded in the cement had broken, so strong was the bond of the cement.

The tile was made by the Indiana Cement Pipe Co., of portland cement which was probably imported from Germany.

W. Z. Morgan and W. J. Webb, of the Kokomo board of works; Charles Sellers, city engineer, and Fred Davenport, consulting engineer, were present when the pipe was removed under the direction of C. S. Wagoner, of Indianapolis, engineer for the Portland Cement Association.

FIG. 1—BIG TREE SAVED BY THE TIMELY USE OF CONCRETE

How to Use Concrete in Tree Dentistry

BY C. H. THOMAS

Tree surgery is like dentistry, only on a larger scale. The first attention a tree generally needs is careful pruning, removing stubs, all dead and dying branches, and also badly interfering limbs. Cuts should be made on the shoulder of limb removed, and not square up against the main limb or trunk. In removing large limbs two or more cuts should be made to prevent stripping of the bark where final cut is made. The result of leaving stubs is that decay sets in, and it is necessary to fill with concrete. Every cut made with a saw should be painted with some good disinfectant, such as pine tar, asphaltum paint or heavy lead paint.

It is a good plan where large cuts are made to shellac them immediately, then paint over as near the color of bark as possible. When cutting trees back, never cut the top out of trees very far back, as this destroys too much leaf surface, and forever ruins their beauty and creates cavities where cuts are made, and eventually results in hollow trees, weakened and diseased, and the prey to every windstorm that blows. This practice is generally followed because the trees have become too lofty and fear is felt that they may blow over, but decay always sets in where cuts are made, and after a few years the trees are more of a man made menace than a nature made one.

A good many trees have weak crotches caused by limbs growing too close together. This can be corrected if cared for in time by judicious pruning, when the tree is young. Weak crotches are strengthened by bolts and chains or twisted wire. The height of brace depends on limbs braced.

In treating trees with concrete, great care should be taken to remove every particle of diseased wood. After decayed and diseased matter has been completely excavated, immediately shellac the edges of both bark and sapwood and sterilize the interior of the cavity with creosote, and over this apply a heavy coating of tar or asphalt paint. The cavity all prepared should be studded with nails, wire bolts and sometimes heavy iron reinforcements. The amount of bracing depends upon the weakness of the tree at the point filled. Portland cement and clean, sharp sand, one part of cement to two and one-half parts sand should be used, thoroughly dry mixed, adding water to make a rather stiff mortar. The mix is placed in the cavity in blocks about 1 ft. thick, thoroughly tamped, with tar paper between each block. After the cavity is filled, allow it to harden slightly, then trowel off to edge of the bark. After thoroughly hardened, paint with cement paint as near color of bark as possible.

FIG. 2—A HORIZONTAL JOB OF TREE SURGERY

FIG. 3—A DIFFICULT JOB IN THE CROTCH OF A TREE

FIG. 4—TREE BARK IS HEALING OVER THE CONCRETE "FILLINGS"

Cost Accounting in Products Manufacture

The Relation of Management to Profits

By Mac Hanson

This is the first of a new series of articles by Mac Hanson (a concrete products manufacturer) written for concrete products manufacturers to help them make money by learning their costs. The cost keeping methods are not theoretical—they have been and are being used and require only a few hours a week for the usual products plant.

One of the most senseless, utterly foolish, almost criminal things any business man can do is to price his goods for sale without knowing their full cost. If such a business man be a manufacturer, then our condemnation is not strong enough. For the latter is even more foolish than a merchant. A merchant knows his prime costs definitely. They are the invoice price plus freight and drayage. His overheat costs—i. e., cost of doing business—are pretty stable. In fact, the overhead costs for all merchants in his line for any given size of business are pretty nearly standard.

For example, a hardware merchant in my town or your town or any other town of about five thousand inhabitants can arbitrarily say that it costs 20% to do business, and not miss it far at that. Without keeping any system of cost accounting at all, he can use that figure and feel pretty sure of keeping out of the hole.

But a manufacturer can do no such thing. A manufacturer in one town of five thousand, doing an annual business of $25,000.00, may have an overhead cost of 15%, but a manufacturer in the same line, in another town of same size, doing the same amount of business, may have an overhead cost of 25% or30 % or more. There is no standard "cost of doing business" in the manufacturing game.

The prime costs of the two manufacturers mentioned in this example ought to be about the same for the same quality of goods. By prime costs we mean the cost of materials and of productive labor. There is, of course, some small difference in the market price of these two commodities in different localities. But the indirect costs—overhead costs—of different factories vary greatly. There are innumerable causes for this, but possibly they could all be summed up under the general headings of management, volume of sales, and amount of investment.

These three things bear an intimate inter-relation to each other. The relation of investment to profits was discussed in the March number of Concrete, under the title "Products Plant Investment, Production and Profit." The relation of volume of sales to protfis was discussed in the April number of Concrete, under the title "Diversified Manufacture." The relation of management to profits will be discussed in this article.

No manager can manage intelligently without knowing his costs and knowing them accurately. A good cost-finding system should periodically—at least monthly—be recapitulated into a manufacturing statement. This statement, compared with former statements, will show the trend of the business of manufacturing; will show where expenses are increasing, losses are occurring, or where gains are accumulating. An analytical study of this statement, in connection with the cost sheets themselves, will show why the gains and losses are occurring. This knowledge of what, where, and why things are happening is essential to good management.

The manufacturer who does not accurately know his costs, wrongs himself, his fellow-manufacturer, or his customers. If he is selling at or below cost, he is wronging himself and his fellow-manufacturer. If he is selling too high, he wrongs his customers. Probably in this latter case he will wrong himself, too, for doubtless he will reduce his volume of business by too high a sales price. Consequently every manufacturer ought to have some system of cost finding, that will give him an accurate idea of his prime costs, production costs, and cost of goods sold.

Materials cost plus direct labor costs gives prime cost; prime cost plus manufacturing expenses of all other kinds gives cost of production (also called cost of manufacture, or factory cost); cost of production of that part of the goods sold plus administrative and selling expenses gives cost of goods sold.

In working out a system of cost accounting for concrete products manufacturers, we will try to keep these three classes of costs distinctly separated.

We just now used the phrase "cost of production of that part of the goods sold." This, in itself, indicates two things. First, that administrative and selling expenses will be charged only to such goods—not to all goods manufactured. Second, that some system must be developed to determine this "cost of production of that part of the goods sold." This, as you all know, is done by means of the inventory. However, later in this article we will discuss the "pereptual inventory" plan and the necessary forms for keeping it; and state its advantages—in fact, its necessity—over the periodic inventory plan.

In this connection, we might mention that not all materials purchased—nor all manufacturing expenses incurred—are used up entirely in the products already manufactured at any given date. There will be lots of materials yet in storage unused—and lots of manufacturing expenses incurred but not all chargeable to the products so far manufactured—and, therefore, an inventory of materials in storage—and of expenses deferred, that is, held up until they become chargeable to manufactured products—an inventory of these two things must also be kept in addition to the inventory of manufactured goods on hand. After one becomes familiar with the system of cost accounting, it is urged that the administrative and selling expenses be charged on an accrual basis and an inventory be kept of these expenses, too, so as to get the deferrable charges into the next period where they really belong, instead of burdening this period with expenses not proprly belonging to it. It makes the cost accounting more accurate and is in accord with good accounting practice.

Let us begin at the bottom in this business of building up a cost accounting system. The first division of our costs was materials cost, which, with productive labor, gives the "prime costs." We must first determine all the elements in the cost of materials, and what constitutes productive (or direct) labor as differentiated from indirect labor, and then devise records to keep these costs. For most of us, raw materials consist only of cement and aggregates. Some manufacturers will

JAN 1 1922 — COST - ESTIMATE - SHEET — RAW MATERIALS

COST OF SAND PER TON		COST OF CEMENT PER BAG NET		COST OF COAL PER TON	
F.O.B. FACTORY	1.36	F.O.B. FACTORY	.54	F.O.B. MINES	3.75
UNLOADING LABOR	.15	UNLOADING LABOR	.01	FREIGHT	1.61
SHORTAGE IN WEIGHT	.03	CEMENT LOSS IN STORAGE	.005	UNLOADING LABOR	.20
WATER SHRINKAGE	.03	SACK LOSS IN STORAGE	.003	LOSS IN STORAGE	.10
INTEREST ON MONEY	.00	BUNDLING, LABOR & WIRE	.003	SHORTAGE IN WEIGHT	.20
EXPS. OF UNLOADING SYSTEM	.01	FRT. & DRAYAGE ON SACKS	.007	INTEREST ON MONEY	.00
TAXES — MUNICIPAL	.01	INTEREST ON MONEY	.000	EXPS. UNLOADING SYSTEM	.01
LOSS IN STORAGE	.01	TAXES — MUNICIPAL	.002	TAXES — MUNICIPAL	.01
STORAGE ROOM EXPENSE	.00	EXPS. UNLOADING SYSTEM	.007	RE-HANDLING	.10
THEFT & SHORTAGE LOSSES	.01	STORAGE ROOM EXPENSE	.001	STORAGE ROOM EXPENSES	.01
		THEFT & SHORTAGE LOSSES	.002	THEFT & SHORTAGE LOSSES	.01
PER TON	1.61	PER SACK	.575	PER TON	5.00

FIG. 1—COST ESTIMATE SHEET OF RAW MATERIALS

also have reinforcing, others have coloring materials, etc.

The following items enter into the cost of cement in the storage room. Net invoice price (i. e., less the sacks), f. o. b. factory, thus including freight and demurrage, if any; hauling expense, or other delivery expense, or unloading system expenses; labor of unloading and storing; loss of cement in storage; loss of sacks in storage; bundling sacks expense—labor, wire, etc.; drayage and freight on sacks returned; interest on money tied up in cement while in storage; local taxes on cement in storage; overhead charges of storage room itself; theft and other shortage losses of cement in storage.

Thus we see that raw materials have their overhead expenses. Immediately the question arises, how can we know exactly what these overhead expenses will amount to, until the end of the year, or at least until the end of a month, or two or more months? Because, for example, it may be that our storage room is in good shape at the beginning of the year, but before the end of the year we may have to re-roof it, or re-floor it. Now re-roofing is an overhead cost of the storage room. And all overhead costs of the storage room form one item of the cost of materials in that storage room. The same argument could be made about taxes, or loss of cement in storage, etc. Therefore, we won't know what the actual overhead charges against materials are until the end of the year.

That is exactly right. We don't know, and we can't know until the end of the year. But there is a simple way around this difficulty and it develops the first principle of any accurate cost accounting system for a manufacturing plant. And this principle not only applies to the overhead costs of materials, but also to the manufacturing expense, to the cost of goods sold, and to the ultimate selling price itself.

It is this: A separate "cost estimate" sheet, or record, must be worked out for each of the four factors just mentioned. This "cost estimate" sheet is worked out at the beginning of the year, for the entire year, by the manager or other proper official. It is based on the "actual costs" of the previous year, or better still, of the previous several years, with due allowance for changed conditions, prices, etc. It is merely a shrewd, intelligent, itemized guess as to what the expense for the new year will be. Any experienced official with the "actual costs" of previous years before him, ought to be able to make a close estimate in the new year's overhead expenses.

This principle of the "cost estimate sheets" or records, in itself, suggests the next basic principle of an accurate accounting system, which is this. A sheet, or record, of the "actual overhead expenses" must be kept as these actual expenses occur. And this "actual overhead expenses" sheet must be totaled by items, periodically—preferably monthly—and these totals averaged to see if the "actual expenses" are averaging higher or lower than the estimated expenses. The "cost estimate sheets" must then be corrected to fit the findings of the "actual expenses sheets" and this new cost estimate used from then on until the next period makes another adjustment either way in the cost estimate sheets.

This whole process is very simple. But do not let that statement fool you about its importance. The business of making the cost estimate sheets and of keeping the actual expenses sheets and then correcting the cost estimate sheets, is the most important, the very fundamental, the basic principle of knowing the cost of your products in its entirety as the basis for establishing your retail price.

It is in this one thing—the cost estimate sheet—more than in any other single thing, that your chance for success or failure lies. Because your selling price is always based on costs—overhead costs—that are always estimated. Never on the actual costs. Above all things, if you do not follow out any other suggestion in this article, at least do yourself the justice of following this one.

Make out your cost estimate sheets at the beginning of the year as carefully as possible. Then faithfully and religiously correct them monthly by the averages obtained from your actual expenses sheets. If you do this, you will never price your products at less than cost, except it be knowingly.

Let us work out cost estimate sheets for materials in the storage room. Aggregates consist of sand, pea gravel, pebbles, concrete gravel, or bank-run. Also limestone, grits, etc. We will use sand only. Coal is not a raw material. It doesn't as such go into our products at al. It is not a prime cost item. It is a manufacturing expense—i. e., an indirect expense. But since, if we operate by steam power, it has similar overhead expenses to cement and sand, we will, for convenience, run its estimate here, too. We will list the expense items and give the probable estimated costs of a factory buying cement in cloth bags, and storing sand outside and coal inside.

Let us examine the estimated cost of cement in the storage room. The first two items we know definitely, each for his own factory. If a leaky roof or other source of wetted cement has ever caused us loss of cement, then such expense should be allowed for and any future expenses of this kind anticipated. Likewise as to loss of sacks. The rest of the expenses down to "storage room expenses," we all know that we have and they are directly an expense of buying, storing, and using cement. Since part of our building room, or factory building, is set aside for storing cement, then the overhead expense of this store room is also a direct expense of buying, storing, and using cement. Theft, or shortage from some other cause, generally occurs to a greater or less degree to all of us, and is a direct overhead expense of cement. These items together, then, make up the cost of a bag of cement in the storage room, not including the lease rental charge on the sack itself.

The items under cost of coal and cost of sand are similar except the item under sand entitled "water shrinkage." It was presumed that washed sand was bought from a commercial plant by weight—per ton. Inasmuch as the sand was flooded into the car with water, the manufacturer paid for a lot of excess water. And the item, "water shrinkage," which means "loss in weight due to the evaporation of excess water," was charged, in order to add to the cost of sand proper, the amount of money paid for mere water. Because when the manufacturer uses the sand, the excess water is no doubt gone—evaporated or drained away.

The amounts of money charges set opposite each item on this cost estimate sheet will be used as the cost of these materials until February first, when they will be

corrected from the averages of the actual expenses sheets, and the new cost estimates will then be used until the next adjustment period.

Let us now design forms to enter the actual expenses as they occur. A suggested form is shown in Fig. 2. It is self-explanatory, in general. Similar forms will be used for sand and coal. The entire expense of each item of costs of all materials is set down as the expenses occurr. No attempt is made to spread the actual expenses over one or more months. The cost estimate sheets do the spreading of expenses as the materials are used.

All the actual overhead expenses of cement can be positively known as they occur if cement is bought in cloth (or paper) bags. Even "loss of cement in storage" and "loss of sacks in storage" and "theft or shortages loss" can be known by the actual count taken in a physical inventory. If, on the other hand, cement is bought in bulk, then the first and last losses just mentioned cannot be known accurately, for there can be no "count" made. The nearest approach to a "count" would probably be the measurement of the length, width and depth of the bulk cement still in the bin, and a close approximation thus derived.

If the cement were actually weighed at inventory time (generally an impractical process), then the actual losses could be accurately determined. Or whenever it happens that the bulk cement bins are completely emptied, then the actual losses could be determined for that period of time from when the storage bin was last empty until this time when it is empty.

As such a thing would not likely happen often in a factory that was running steadily, some other means of getting the entries, or charges, for these losses must be used. In the case of "loss of cement in storage" by wetting, or hardening from other causes, it is best to weigh this lost cement and enter the actual expense. The column for "theft or shortage loss" can be left blank until the bulk storage bin does become empty and such expense actually determined. But it would be better business practice to make an entry in this column each time a physical inventory is made. Such an entry would be very largely in the nature of an "estimated" expense, instead of an "actual" expense, as the physical inventory itself of bulk cement would have to be more or less of a close approximation of cement on hand.

But such an estimated "actual" expense could be finally corrected to actual facts when the bin did finally become emptied. Having such an in-accurate entry in this column at each physical inventory period would be better practice than having no entry therein until the bulk cement bin actually became emptied, provided the bin seldom becomes empty.

This line of reasoning will apply to making the entries in the like or similar columns on the "actual expenses" sheets for sand and coal. If, as is quite generally the case, coal is neither weighed nor measured in using it, then there can never be any entries on the actual expenses sheet for "loss in storage" from deterioration, theft or other causes, and for "shortage in weight." But the cost estimate sheet should carry entries for these items as a matter of protection against such losses.

Likewise, if sand is neither weighed nor measured in using—which is very bad practice, and a fault that should be at once corrected if it exists in your plant—then there could never be any entries of the actual expense on the actual expenses sheet for the items "shortage in weight," "loss in storage," and "water shrinkage expense." Since you know the weight of your products and the mix you are using, i. e., ratio of cement to sand, or, at least, think you know the mix, then the weight of the sand used could be determined from the weight of the products manufactured.

At each physical inventory period a close approximation of the total shortage in weight from all causes at that time could be made, and this total distributed to the three items mentioned according to your best judgment based on observation and experience. Cement is always weighed or measured as it is used, so that, as mentioned before, its entries for such items will be a little more accurate.

The original entries, which will form the source or

JAN 1, 1922 — ACTUAL EXPENSES OF CEMENT

DATE RECEIVED	NAME OF SHIPPER	ADDRESS OF SHIPPER	CAR INITIAL AND NUMBER	TOTAL INVOICE (INCLUDING FREIGHT)	LEASE RENTAL CHARGE ON SACKS	NET INVOICE (EXCLUDING FREIGHT EXCESS ON SACKS)	TOTAL NUMBER BAGS OF CEMENT	DEMURRAGE	UNLOADING SYSTEM EXPENSE	LABOR-UNLOADING AND STORING	VALUE OF CEMENT LOSS	VALUE OF SACKS LOSS	HANDLING SACKS EXPENSE-LABOR & WIRE	DEVAGE ON SACKS RETURNED	FREIGHT ON SACKS RETURNED	LOCAL TAX PAID ON CEMENT	STORAGE ROOM EXPENSES	VALUE OF THEFT AND SHORTAGE LOSS	TOTAL EXPENSE FOR WEEK OR MONTH	AVER. EXPENSE PER SACK - WEEK OR MONTH
1ST WEEK																				
2ND WEEK	LEHIGH	-	MC 42741	378 88	59.20	319 68	592	-	SPIKES .25	6 75	-	-	15	-	-	-	RENT 1 20	-	325 03	
3RD WEEK	-	-	-	-	-	-	-	-	-	-	-	-	.20	25	.90	-	-	-	1.35	
4TH WEEK	-	-	-	-	-	-	-	-	-	-	-	-	.10	-	-	-	-	-	.10	
5TH WEEK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
ONE MONTH TOTALS	-	-	-	-	-	319 68	592	-	25	6.75	-	-	.45	.25	.90	-	1 20	-	326.48	
ONE MONTH AVERAGE PER SACK						.54	-	-	-	.012	-	-	-	-	.002	-	.002	-	.552	557
1ST WEEK																				
5TH WEEK																				
2ND MONTH TOTALS																				
2 MONTHS TOTALS																				
2 MONTHS AV PER SACK																				

FIG. 2—SUGGESTED FORM FOR ENTERING ACTUAL EXPENSES

sources of posting all items to these sheets, except shortages and losses, will generally be found on a form for keeping records of factory operations, which form will be illustrated and discussed in the next installment of this article. Other sources will be the invoice file, the cash book, and the inventory book or sheets.

The difference between the prior inventory and the current inventory which gives the cost of goods sold, when compared with a physical inventory which should be taken periodically as a check on the perpetual inventory, may show that the sales do not account for all the difference in the prior and the current inventories. This indicates a loss from some cause and forms the source for making entries for losses and shortages, as just discussed.

Certain expenses of the business as a whole will have to be pro-rated, or distributed, to the various departments, that is, to the various accounting divisions, of the business. Examples of such expenses would be taxes, monthly telephone bills, etc. A basis for pro-rating taxes can be obtained from your copy of your assessment sheet given you by the local assessor, or from your inventories of the date of assessing in your state. If your taxes are not large, they could be run into administrative expense as a lump sum, but personally I am favorable to pro-rating or distributing them to the different materials, buildings, and grounds, stock of finished products, etc. This distribution can be made quite accurately with very little trouble.

The rental charge on the telephone is properly chargeable to general expense, but the toll charges should be distributed to the departments which originated the calls. For example, a telephone call to a coal mining company, ordering a car of coal, will be charged as an overhead cost to coal, inasmuch as we will not keep a separate purchases account in this system of cost accounting.

There is no "materials in process" account in a concrete products manufacturing plant, because all materials are worked up into finished products each day.

An invoice must be secured for every purchase made of every kind—materials, services, freight, expenses, etc.—whether or not payment is made at the time or later. If invoice is not secured from the creditor, then a substitute invoice should be made and filed in the invoice book at the time the purchase is made. These invoices should be pasted in the invoice file in the order of their occurrence. It is essential that the invoice file be carefully kept, as it is one of the original sources of ascertaining cost items to enter on the sheets of the various accounting divisions. Firms desiring a neater, more business-like or more systematic procedure can use a filing case, numbering the invoices. The voucher system is recommended for those in a position to properly use it, as being in accord with better accounting practice.

But as this article is primarily written in the interest of the manufacturer who has no accounting system at present, only the simplest procedure and that requiring the least clerical work, will be presented. It is recommended that those firms who can financially do so, install a complete double-entry bookkeeping system. Since the double-entry system still requires cost sheets to make it complete, this series of articles should suggest valuable ideas.

The small manufacturer who cannot afford to, or who does not care to go to the expense of printed forms, can draw excellent forms on legal cap paper by hand and have as accurate and well kept records as on printed forms.

In Fig. 3 we present a suggested form for a perpetual inventory of materials. The withdrawals, i. e., the materials used, can be entered weekly from the factory record blank to save detailed posting. Whenever a physical inventory is taken, as it should be done periodically as a check on the perpetual inventory, then perpetual inventory can be corrected to that date by an entry to "loss in inventory" on the withdrawal side, or an entry to "gain in inventory" on the purchases side, as the case may be. It will thus be seen that a perpetual inventory is simply a clerical record of materials purchased and of materials used. The difference between the two on any date gives the inventory of materials in store as of that date, without the necessity of a physical count.

PERPETUAL INVENTORY OF CEMENT

1922 DATE		PURCHASES ITEMS		AMOUNT		DATE		WITHDRAWALS NO SACKS USED	VALUE	
JAN	10	592 BAGS LEHIGH	2.5	3.10	68	JAN	14	120 BAGS SMALL TILE	64	80
MAR	20	592 " UNIV.	2.5	3.10	68		21	200 BAGS STAVES	108	00
							28	100 BAGS BLOCKS	54	00
						FEB	11	72 BAGS TILE	38	88
							18	100 BAGS TILE	54	00
									317	68
						MAR	25	480 BAGS SMALL TILE	259	20
							31	112 BAGS BLOCKS	60	48
									317	68
APR	3	300 BAGS ATLAS	2.5	186	00	APR	8	300 BAGS STAVES	162	00

FIG. 3—SUGGESTED FORM FOR PERPETUAL INVENTORY

It is because of this feature—that a physical count is not required—that a perpetual inventory is a necessity in any good cost accounting system. Otherwise the great labor and time involved in making a physical inventory would cause a manufacturer to do without a knowledge of his costs for long periods, even as long as a year, as often happens. Forms for perpetual inventories of sand, coal, and other materials are similar in design and operation to that for cement.

The other element of prime costs, viz., productive or direct labor, has no overhead expenses. Neither does it require any inventorying, as it is all used up each day and enters into the products manufactured that day. It is not deferred. A record of it is kept on the payroll, which no doubt every manufacturer has, so no form will be illustrated here. But under the discussion of manufacturing expense we will illustrate a form for keeping records of factory operations and the distribution of labor to the various operations will be shown on that form.

Direct or productive labor is that which is applied directly to the process of manufacturing. All other labor of manufacturing—indirect labor—will come under the heading of manufacturing expense. This is in accordance with good accounting practice.

As mentioned before, these articles are written primarily for the manufacturer who does not yet have such a system. Usually this means the small manufacturer. But the articles contain valuable ideas for any manufacturer of concrete products, no matter how large his business.

The next article in this series on cost accounting for Products Manufacturers will deal with "manufacturing expense" —forms and discussion of their use.

How to Make Forms for Concrete Buildings —*Flat Slabs*

The Fifth Article of an Important Series Written for the Builder Who Wants to Know the Subject From the Beginning

By William F. Lockhardt
Lockhardt-Byrne Co., Inc.
New York City

The literature of form work is scanty. It especially fails to meet the needs of builders who are obliged to begin at the beginning to study the subject. Contractors and superintendents have repeatedly asked Concrete to publish articles whose authors would not take it for granted that their readers already knew most of the subject. The editors cast about for the right man to prepare such articles, and were fortunate in getting the promise of William F. Lockhardt to do the job. Articles on forms for Footings, Columns, Walls, and Beams and Girders, have been published in four previous issues, and the series will be continued. The present article on Forms for Flat Slabs is in two parts, of which the first part only appears this month. Mr. Lockhardt's descriptions of form work are based on the actual practice of some of the most successful concrete building contractors in the United States. Various methods have been tried, and these methods have survived. If any reader is in doubt about some step in form building, when he has read Mr. Lockhardt's article on any one of the special subjects in the series, he will be conferring a favor on the editors and on many readers if he will ask to have the point more fully explained. A reader who has used form building methods different from the methods here described, and which he believes better for any reason whatever, will be adding something to the consideration of a very important subject if he will describe those methods for this magazine.—The Editor.

In spite of the fact that there can be nothing much simpler than a system of flat slab forms, there are probably as many different methods of constructing them as there are superintendents or carpenter foremen. The fact that the floor forms simply constitute in effect a large level platform over the whole floor area, broken only by the depressed panels around the column capitals, makes it possible for each man to exercise his ingenuity in the arrangement of shoring, 4 in. by 6 in. ledgers and 3 in. by 4 in. spreaders. Several of these different systems have merits that have kept them in use, and justify their inclusion in this series.

There is a wide difference of opinion among contractors as to the relative merits of large and small form units. Some contractors prefer to handle the least possible number of pieces, and accordingly make their panels as large as possible; others prefer smaller panels,

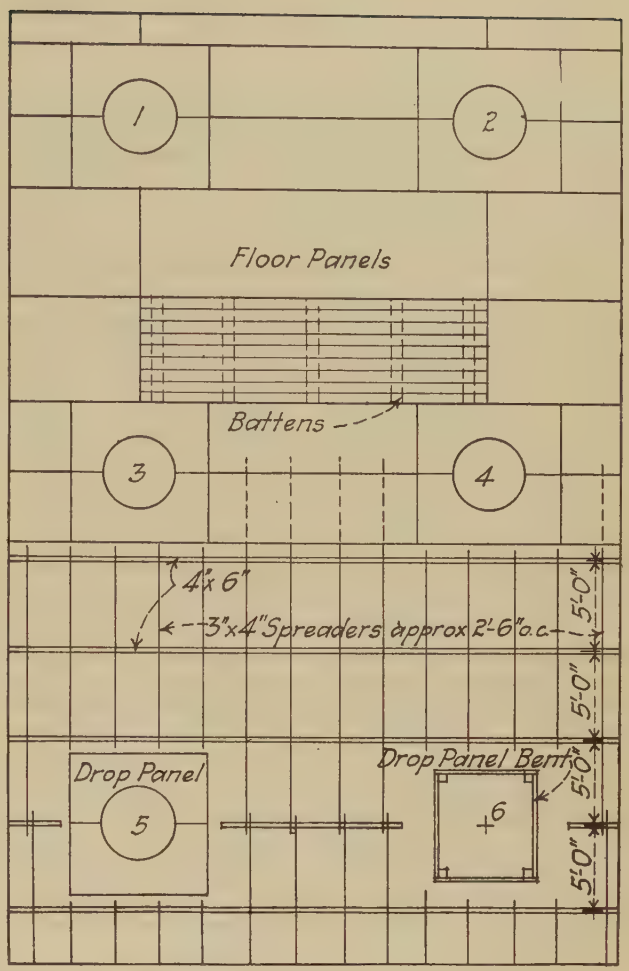


Fig. 1—Loose-Spreader System of Flat Slab Forms

which may be handled by a lesser number of men. The choice of the particular system to be followed depends entirely on the size and character of the job and the speed required.

On a large structure running on a schedule of a completed floor per week, there will usually be sufficient work in taking down, carrying and hoisting forms to keep a gang on this one branch of the work alone. Under these conditions the panels may be made of large size, as there are always sufficient men available to lower, carry and hoist them. Large panels facilitate the progress of the work on the floor, and as the increased carpenter labor to place them is less proportionately than the increased area placed per day, lower costs result.

On large jobs, too, it is usually necessary to keep at least one gang on the floor practically all the time, placing reinforcement. To keep them at work economically the formwork must advance across the building fast enough to enable them to work to advantage.

Where the building is smaller conditions are much different. The stripping gang is generally insufficient to carry on this work alone, and must usually be reinforced by the addition of men from the concrete or other gangs when there is no concreting going on. Under these circumstances smaller panels are often an advantage, as they can be handled by a smaller crew. This often enables stripping and hoisting to be done at times when it would otherwise have to stop because of inability to get the extra men needed from other gangs to handle the large panels.

The gang on reinforcement, too, is smaller and generally takes care of the work of bending in the yard, as well as the placing on the floor, and if their progress is delayed for part of a day because some of the floor

is not ready for them, they may be readily shifted downstairs to work on spiral fabrication, bending column hoops, stirrups, etc.

The best results in form work are not obtained by blindly following what somebody else has done, but by an intelligent analysis of the conditions governing the particular job in hand, and the adoption then of the methods best suited to that particular piece of work.

One of the oldest, simplest and most used methods of flat slab form construction is shown in Fig. 1. The upper part of the drawing shows the disposition of the panels and the lower part of the drawing the arrangement of 4 by 6's and spreaders.

For the sake of simplicity in this and other drawings, the shores have been omitted. Their spacing under the 4 by 6's is governed largely by the thickness and consequently the weight of the floor slab, which limits the span of the 4 by 6's. It is worth noting that 4 x 6's are now generally used for ledgers instead of the former 2 by 8 or 2 by 10 plank. It was expensive work cutting a seat in the end of the plank to hold the plank securely, but if this was not done it was found that cleats alone could not be relied upon. The plank when put in place were green, and if a delay occurred in pouring the first floor they would warp and cup in seasoning. On winter weather jobs the heat of the salamanders would sometimes cause them to curl violently and force off the cleats which held them in bearing on top of the shores, with a consequent failure of part of the floor form system. This unfortunately was most likely to happen when the greatest number of fires were in use, which was of course after the slab had been poured. As a 4 by 6 will usually carry a sufficient load and be more stable, plank ledgers have been generally abandoned.

As shown in the lower right hand corner of the sketch the column bent previously described in the articles on "Columns" and "Beam and Girder Forms" is set up in position at the column center. The drawing is made up for a bay 20 ft. by 20 ft., so that the lines of 4 by 6's work out 5 ft. o. c. The exact figure will vary with the size of the bay, but it is usual to space them from 4 ft. to 5 ft. apart. The 3 by 4 spreaders are laid loosely on top of the 4 x 6's at right angles to them, as shown by the single lines in the drawing. The floor panels themselves are made up of the customary 7/8 in. roofers, with 1 in. by 4 in. or 1 in. by 6 in. battens on the back about 3 ft. o. c. These battens serve no purpose other than to hold the panel together in handling, as the panels are laid directly on the spreaders, which are shifted slightly to one side or the other when they happen to come exactly under a batten.

In this and other loose-spreader systems the breakage of the 3 x 4's is likely to be high, partly because they are usually very long and break readily, and partly because they will sometimes project out across the ceiling past the point to which it is desired to strip. The stripper foremen will then have to chop or break them off to get out the last panels. This can be largely avoided by having the spreaders lap in the center of the bay, instead of on the column center line, as shown in the drawing. Stripping is always carried back to the last available fill joint to get the use of as many panels as possible, and as the fill joint is always in the center of the bay, the spreaders should lap at that point. Then should the end of a spreader project a few inches past the joint and pin a panel fast to the ceiling, it is usually possible to free the panel without cutting the spreader.

An interesting system of forms for jobs in which the bays are square and in which the drop panels can be made of the right size, is shown in Fig. 2. These

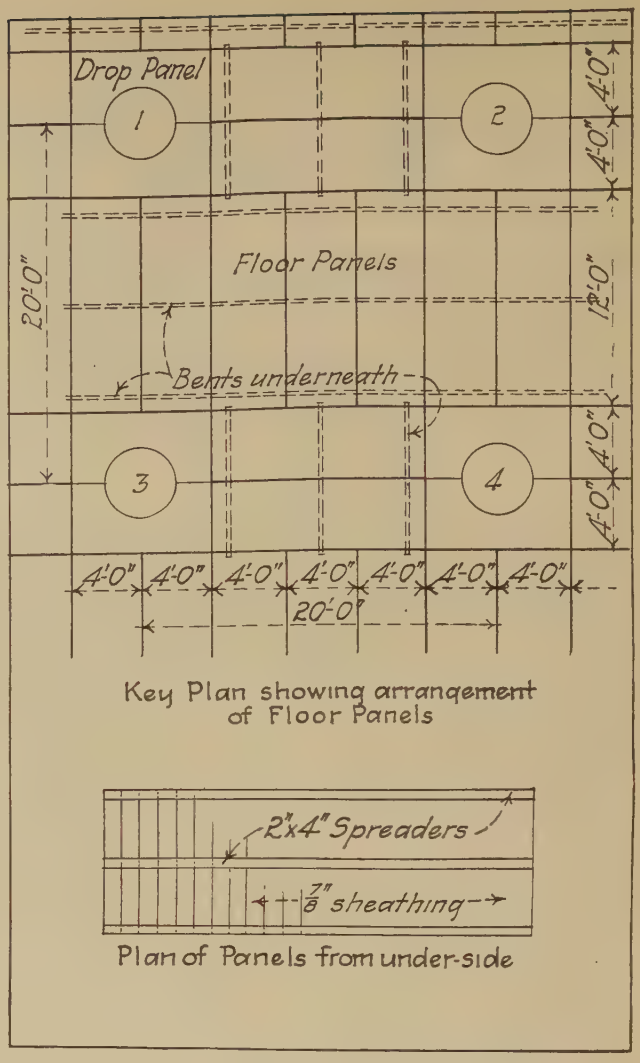


Fig. 2—Flat Slab Form System for Buildins with Square Bays

panels are all exactly the same in size and shape and are therefore completely interchangeable, which is a big advantage where time is limited and the job must be pushed. The drop head shown is two-fifths of the length of the bay. As will be seen, three rows of 4 x 6 bents are set up between the lines of columns, the same as in Fig. 1, but between the columns three short bents are used running in the opposite direction. Because of the close spacing of the 3 by 4's or 2 by 4's, which act as battens on the back of the panels, they are usually quite stiff and stand handling well, in addition to being somewhat lighter than the panels used in the first system described.

This system is open to the objection that the board marks do not all run the same way on the ceiling, but as a rule because of the rigidity of the panels a good job of formwork is obtained, and when the ceiling is painted the fact that in some panels the boards are at right angles to those in the adjoining panels is not specially noticeable or objectionable.

A particularly excellent method of building forms is shown in Fig. 3. Instead of making the panels with longitudinal spreaders on which the boards are placed crosswise, as shown in Fig. 2, these panels are made up very much like those for beam and girder construction, the boards running the length of the panel, with traverse spreaders on the back spaced according to the load to be carried and the span between the rows of 4 by 6 bents. As the longitudinal joints between the panels come over the center line of the 4 by 6's, accur-

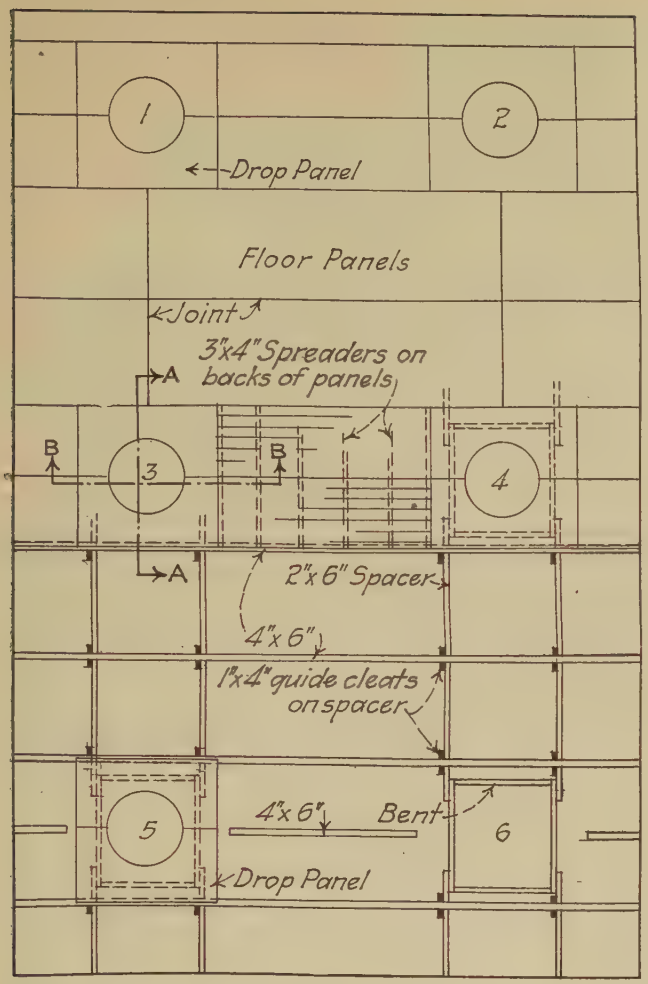


Fig. 3—A System of Flar Slab Forms That Has Been Found Very Practical

ate spacing of the bents is essential, and is obtained in the following manner, which is also shown later by sketch. A 2 by 6 spacer plank is bolted from one column bent to the next one, at right angles to the line of 4 by 6's. These 2 by 6's are all drilled for the bolts to a standard spacing, so that they automatically furnish a check on the location of the column bents. Each 2 x 6 carries a set of 1 by 4 guide cleats, which project about 4 in. above the top of the plank, and so located that it is only necessary to drop the 4 by 6's into the space between the guide cleats to ensure their being exactly in position to catch the edges of the panels. One 4 by 6 bent is needed between the columns parallel to the rest of the 4 by 6's, to catch the two short panels. This bent can be readily placed after the other bents are up by the use of stay-lathing on which the position of the bents has been marked. As the 2 by 6 spacer plank does not actually carry any of the construction load, it does not have to be bolted up with nut and washer.

The operation of setting up these forms then becomes quite simple. After the first column bent has been properly located with regard to its column center in both directions, it is only necessary to locate the succeeding bent in the same row approximately. The 2 by 6 is lifted into position at the first bent and pinned with a bolt. The second bent is moved backward or forward until the other end of the 2 by 6 can be pinned the same way and the process again repeated. The 4 by 6's are then dropped into place between the guide cleats and the shores placed under them, after which the panels may be laid down with the assurance that everything will fit as it should. Because of the fact that everything is so nearly automatic, some carpenter foremen claim to be able to get better form costs with this system than with any other type of flat slab forms.

A system of flat slab forms in which use was made of the 2-in. plank underflooring was described in Concrete some time ago, and is summarized briefly here for the benefit of anyone who is not familiar with this idea. In mill buildings of some types the drop head around the column capital is occasionally eliminated in the structural design, in order to get a perfectly flat, unbroken ceiling. It then becomes possible to use the 2-in. plank underflooring for form construction, and save a large part of the cost of lumber which would otherwise be wasted. As the plank are used practically loose, there is 100% salvage. The plank are used only once, being left on the floor for use as underflooring after being stripped, and a new set of forms "built" for the next story. The shores, ledgers, etc., of course, are used over again on each floor.

Reference to Fig. 4 will show the principal details of the system. The shores may be made up of plank if desired, and are usually very stiff, but the salvage is then not high on this material. For the reasons given in the first part of this article, it is not advisable to use the plank for ledgers, unless a "T" shore is used, such as may be built of plank, so that the ledger may be adequately secured against overturning under load.

The matter of adequate support for the green concrete in a flat slab floor is one to which a great deal of thought has been given by engineers and contractors. Whatever the system of forms used, this point must be watched very carefully to see that by no chance is the new slab left without proper support, either during the stripping operation, or in the period immediately subsequent to it. Flat slab forms should not be removed earlier than indicated in the schedule below, which is based on the prac-

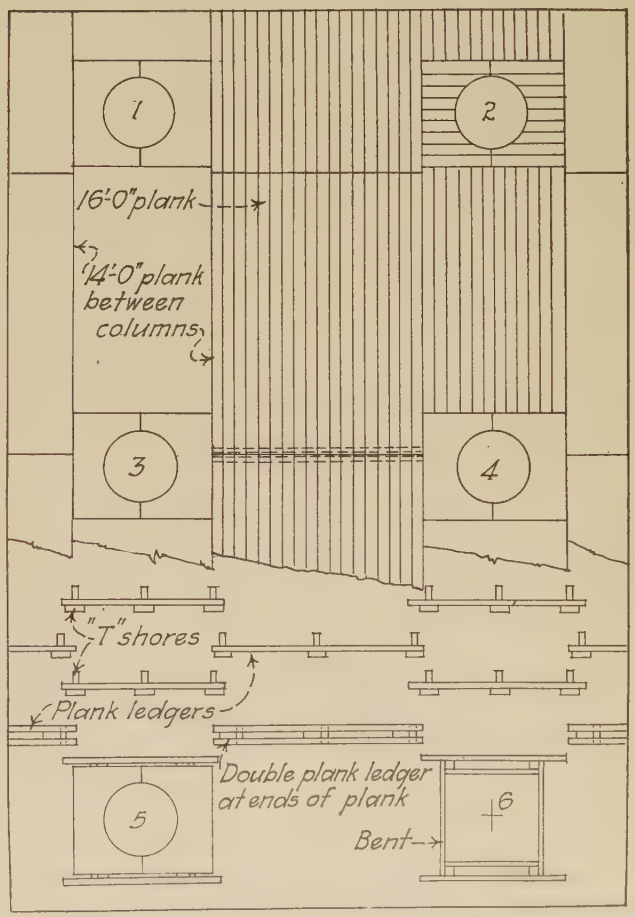


Fig. 4—Loose Plank System of Flat Slab Forms

tice of a firm that has successfully handled much of this work.

Columns—24 hours after slab is concreted.
Depressed heads (drop panels)—36 hours after concreting.
Slab—84 hours after concreting.

This schedule, like that given in the preceding article on beams and girders, is intended for summer or warm weather conditions. For cold weather these times should be increased.

Because the construction of flat slab forms is such that it is frequently necessary to remove the shores from a large part of a bay in order to start stripping, it has been found advisable to build in what are known as "permanent" shores. These shores are usually 6 by 6's carrying a "cap" about 12 in. square, which is entirely independent of the adjacent floor panels. This shore is set in the approximate center of the bay at the joint between two panels, which are notched out around the "cap." When the panels are stripped the permanent shore remains in place to afford support to the concrete. The function of the permanent shore cannot be performed by reshoring, for two reasons: First, because of the injurious deflection which will occur if the slab is temporarily left unsupported; second, because in reshoring, the effort to wedge the shore up tightly will often result in putting a heavy pressure on the under side of the slab. The slab is designed and the reinforcement so placed that it is effective only in carrying loads which tend to bend it *downward;* it is entirely unfitted to resist loads which tend to bend it *upward,* and when it is still green may be easily cracked in this way.

The method of reshoring commonly followed involves placing a single 6 by 6 post in the center of each band between the columns. This method is open to the same criticism as applied above to the slab, although there is usually some steel over the bands to resist an upward thrust. Some contractors, in the interest of best practice, insist that permanent shores be built in at these points also.

This requires that a special arrangement of 4 by 6's and spreaders be used, which is illustrated in Fig. 5. An arrangement of floor panels similar to Fig. 1 is used, but with the spreaders placed lengthwise on the backs of the panels. Where long and short panels abut, the spreaders are at the edge of the panel, but where a 6 by 6 shore is placed in the joint between the long panels, the outside face of the spreader is kept 3¼ in. back from the edge of the panel. By arranging the 4 by 6's as shown in the drawing, the permanent shores may be made to help carry them, and take the place of corresponding 4 by 4 shores at these points. There are no loose spreaders in this system, and they appear in the lower part of the drawing only to show their position under the panels in relation to the permanent shores. This system in practice is no more complicated than that shown in Fig. 3, and under some conditions of span actually requires less lumber footage than the apparently more simple method shown in Fig. 1.

To avoid making the drawing unnecessarily complicated, the permanent shores have been omitted from the center of the bays of the other drawings, but they should always be provided regardless of the system used. If a system of permanent shores is used, as shown in Fig. 5, re-shores are needless, but if only the center permanent shore is used, a 6 x 6 re-shore should be placed under each band midway between the columns, in each direction.

Two stories, in addition to the story below the forms, should be left fully reposted at all times, and in the third story below, the shores under the bands may be removed, leaving in place for another week the center shore under the slab.

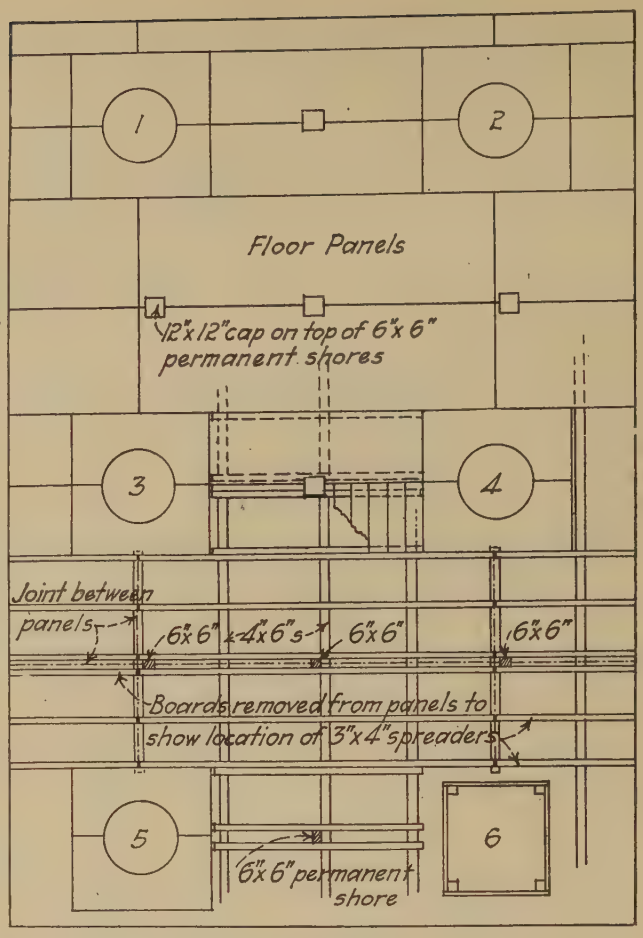


Fig. 5—Flat Slab Forms Designed for Use of Permanent Shores Under Bands as Well as Slab

Because of the nature of flat slab construction it is important that shores be placed one over the other in successive stories, to avoid compelling the floor structure itself to carry the load. Failure to follow this rule may result in bringing a concentrated load to bear on an unsupported section of the slab, with a resulting failure.

It is surprisingly easy to cause a flat slab failure by lack of attention to details of posting and re-shoring. Even if the bay does not come down, the slab is damaged, and it is no credit to either contractor or superintendent that this should happen when it is entirely possible to avoid it.

(To be continued—July Concrete)

A good deal of "how" information about building concrete basement walls, foundations, stairways, and piers is contained in the little booklet, "Concrete Basements and Foundations," recently published by the Portland Cement Association. The book tells in plain language, assisted by illustrations, how to calculate the proper size for foundation walls and piers; how to lay out the work on the ground; how to build the forms, mix the concrete and pour it. Various types of walls are explained and illustrated, and several ways of insuring waterproofness in basement construction enumerated. The book is sent free to interested persons, and may be had by addressing the Portland Cement Association, 111 West Washington Street, Chicago, Ill., or one of the many district offices.

A New Phase of the Shear Problem in Beams

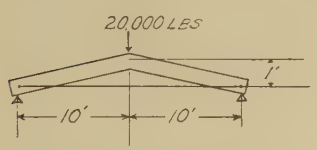
A new feature of shear reinforcement is emphasized in a paper entitled "A New Phase of the Shear Problem in Reinforced Concrete," by Edward Godfrey, namely, the importance of end anchorage, but that anchorage of *bent up* rods. In the paper, which is abstracted below, Mr. Godfrey, whose discussions of concrete design and practice have been published in part in earlier issues of CONCRETE, aims to differentiate between end anchorage of rods that is thoroughly good and that which is "almost good."

Theory and practice in the matter of shear or diagonal tension in reinforced concrete beams have never been correctly joined up in standard works on the subject. There is not in existence a logical analysis of the stress in a stirrup or short shear member, and yet the stirrup or short shear member, or bent up end of a bar of less than span length, are the only standard methods of reinforcing against shear or diagonal tension failure that are recognized by some authorities.

I believe that I have a new light on this subject, and it is with the hope that by reconciling the experimental truth pointed to by advocates of the stirrup with analysis, as well as showing a sound analytic basis for recently recommended practice, referring to the advocacy of full anchorage beyond the edge of support of main reinforcing rods in cases where shear is very high, I may be able to compose some of the differences between my "views" and the assertions of the standard writers and standard makers.

The new phase in the consideration of shear in reinforced concrete beam is this, namely, what has been referred to and considered as shear in concrete is in large part simply the vertical component of a direct compression in an almost horizontal concrete beam.

Given a simple truss, as in Fig. 1, composed of two



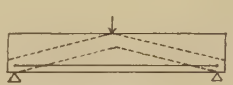


FIG. 1 (LEFT)—FIG. 2 (RIGHT)

top chord members and a tie. Roughly the chord stress is 100,000 lbs. If the top chord has 100 sq. in. of area, the unit stress is about 1,000 lbs. On the 100 sq. in. of cross section of the compression chord, the apparent vertical shear in the chord is about 100 lbs. per sq. in., or approximately one-tenth of the intensity of the compression. It is clear that there is really not a vertical shear in the chord, but a simple and direct compression. But suppose this were a concrete beam, the triangular portions being filled out, as in Fig. 2. It could be said that the beam has no vertical shear provided one thing were true, that is, that the reinforcing rod had a full anchorage beyond the point of support. It is just here that much false interpretation of tests exists.

Investigators have given little thought to end anchorage of main rods, either straight ones or bent-up ones, in planning series of tests and in interpreting results of their tests. It has been my observation that wherever there is good anchorage of main rods beyond the point of support of beam, there will be good shear carrying capacity.

In proper design, plain rods will have anchorage enough, and if full anchorage is required in a short length rod, something better than mere deformity in a bar is needed.

The truss idea may be varied as in Fig. 3. If in this

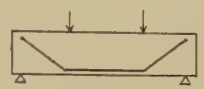


FIG. 3 (LEFT)—FIG. 4 (RIGHT)

figure the steel rod has full anchorage beyond or at the point of support, there is no shear whatever in the concrete member, not even as a vertical component of direct stress. The whole shear of the truss is taken by the steel rod, as a vertical component of the stress in the inclined portion of the rod. By adding concrete to complete the beam, a reinforced concrete beam may be constructed that could be considered to have no shear in the concrete, provided the steel rod were capable of carrying the calculated stress, and provided, of course, that the ends had full anchorage at points over the supports.

Based on experimental research on actual buildings, no diagonal tension or shear cracks would be shown, even with a load exceeding the design load. With end anchorage on the rods the shear of the beam is carried in the safest possible manner, namely, by tension in the main reinforcing steel.

In a large measure stirrups, instead of carrying the beam shear function as lateral reinforcement in a compression member, inclined a little to the horizontal. For in the laboratory tests the bottom rods always extend beyond the edge of support and thus approach the condition of the rod of Fig. 1.

Anchoring the straight horizontal bottom rods in a T-beam and considering the stirrups as lateral reinforcing means that the line of compression drops down at ends of span in a straight line, or curve, and takes in only the lower part of the beam near the ends of span. The upper part of a T-beam makes a good stiff and efficient compression member, but the lower part or stem of the T has only a fraction of the value of the upper part. It is hard to anchor a rod in the small amount of concrete in the stem of a T-beam. Furthermore, end anchorage in the upper part of a beam does not need to be effected beyond a plane vertically over the inner edge of support, as it would have to be for a bottom rod. This allows more room for grip of the rod. These differences are illustrated in Figs. 5 and 6.

Applying this new conception of shear in a beam, namely, compression in an inclined concrete member or tension in an inclined steel member, the ineffectiveness of the so-called shear reinforcement of Fig. 7 is quite apparent.

That the concrete grips the steel rod for its full

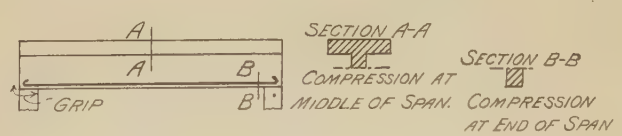


FIG. 5

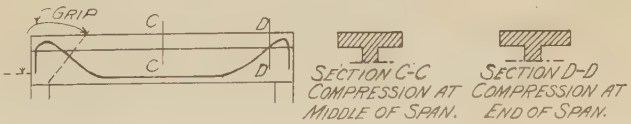


FIG. 6

length is a cardinal principle of reinforced concrete. The bars with the end anchorage are to supplement and not to replace straight horizontal bars in the bottom of the beam. Not all beams and slabs require bent up and anchored rods, for concrete itself will carry safely a very considerable shear. However, a hook or a bend at the ends of horizontal rods is an excellent thing to guard against shrinkage tension.

FIG. 7

Provision for beam shear in the way of steel reinforcement is needed in cases where the beam shear exceeds the amount which the concrete can safely carry, and it is for this excess that bent up and anchored rods are needed and should be figured. Instead of any of the standard ways of reinforcing a beam for shear, it is better from every standpoint to bend up with an easy curve or flat bend some of the rods (about at quarter points for beams carrying uniform loads, or under concentrated loads for girders carrying beams), carrying these rods into the upper part of the beam at supports and anchoring these rods beyond the edge of support, as illustrated in Fig. 8 at (a), (b) and (c).

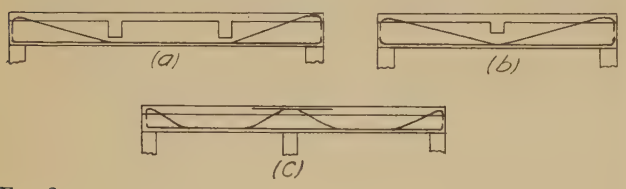


FIG. 8

The method of proportioning this style of reinforcement is to allow a portion of the beam shear to be carried by the concrete, figured in the regular way, except that the entire rectangle enclosed by the width of the beam and its full depth should be included.

There is no good reason for omitting the portion of the rectangle below the rods. On this rectangle of concrete, in beams with this type of reinforcement, particularly if the horizontal rod has a hook or bend over the support or laps the rod of the next span, an allowance of shear of 60 lbs. per sq. in. or even more is favored. The excess shear over this portion, taken as ordinary shearing stress on the full rectangle of the beam, should be apportioned to the inclined and anchored rod or rods. To find the stress in these rods due to this beam shear, multiply the excess shear by the secant of the angle of inclination of the rods with the vertical.

This puts the designing of reinforcement for diagonal tension in a beam on as definite and sound a basis as that of tension rods in a steel truss.

The Hydraulic Stone & Building Co., Trinidad, Colo., whenever possible, draws complete elevations for jobs for which it supplies blocks. The location of every unit is marked. Openings are given a number and each block or unit that goes around that opening is given a key number. As the blocks are made they are marked, and when delivered to the job are piled near the opening for which they are intended. This saves contractor's time. The company has found that this co-operation with the architect and contractor has helped the marketing of its concrete products a great deal.—*Concrete Builder.*

Extinguishing Lumber Fire With Cement

The use of cement in extinguishing a fire in a lumber yard was given only brief mention in the December issue of CONCRETE. This is described more fully by Davyes Throughton, Fire Chief of Seneca, Kansas, as follows:

The Oneida fire started in a general store and spread to the lumber yard of T. M. Wherry and Co., * * * and there being a high wind was endangering other business and residence property. The town has no water system and no special fire equipment, so could only fight the fire by bucket brigades. They called for help from the fire departments of neighboring towns, which had fire equipment. When the Seneca crew arrived the store building was beyond hope of saving and the northwest wind had blown the fire to the lumber shed and piles where it had gotten a very strong foothold. Bucket brigades had already proved ineffectual. Some of the neighboring towns had brought their chemical engines and extinguishers and these had been used with but little success in the open lumber shed. The situation was very bad, as the fire had caught in the northwest corner of the yard and the high wind blowing from that quarter was spreading the fire rapidly to the rest of the yard and made the fire fighting all the more difficult because the firemen had to work with the wind in their faces.

I suggested the use of cement, there being plenty at hand, as a means of checking the fire, but my idea being new to all present I had to back up the suggestion with orders before it was taken up. The method pursued was this: I had dry cement scattered over adjacent piles of lumber, which were in immediate danger of catching, and had this wetted down by the bucket brigade; I had cement mixed with water, making it quite thin, and had this liquid cement thrown upon the lumber which was ablaze. The effects were prompt and pleasing, even astonishing. The spread of the fire was checked almost immediately. No more caught fire and that already burning began to be abated and within an hour and a half the fire was extinguished. I attribute the saving of about a third of the lumber in this yard to the use of the cement.

The dry cement, which was thrown upon the lumber not yet afiire, and wetted down rendered that lumber immune to fire. The fire did not catch in any of the piles so treated. The liquid cement thrown upon the blazing piles had a threefold effect: (1) It acted similarly to dry powder chemicals, reducing the fire quickly. Yet the effect of the cement was even better than that of chemical powder as it acted in spite of the fact that the fire was out-of-doors. (2) It almost entirely stopped the flying of sparks and tinder, thus greatly reducing the danger of spreading fire. (3) It caked over the fire, smothering it and shutting out the air, so that combustion could not take place, thus more quickly and effectively extinguishing it than anything else available.

Another very interesting and advantageous use to which the cement was put was in the case of a large tank of oil (about 400 gallons) in the cellar of the store building. This was an open tank which was ablaze, and into it canned good had dropped and were constantly exploding and throwing the blazing oil all about and greatly adding to the danger of the spread of the fire. Several sacks of dry cement were thrown into this and eliminated this danger.

Everyone was astonished by the results of the use of the cement. I believe that we could have made even more effective use of the cement had we some means of forcibly throwing the liquid cement upon the fire. We had great difficulty in getting the cement upon the fire itself. We were throughout handicapped by lack of fire fighting facilities, but I feel that by using the cement we stopped a fire which would otherwise have entirely destroyed the lumber yard and possibly other property.

Sliding doors on garages having concrete floors sometimes run in grooves in the pavement. To insure a free-running door and at the same time preserve the edges of the concrete, embed a small channel iron in the concrete, bonding the iron to the concrete by bolts. Metal "nosing strips" such as used in the edges of stairs, can also be used advantageously.—*Contractor's Atlas.*

Septic Tanks

Many Types to Meet an Increasing Demand in Suburban and Rural Communities

A demand for more modern and convenient water and sewage systems for homes in the country and undeveloped city suburbs has made necessary some effective and inexpensive means of sewage disposal. Otherwise the drinking water may become polluted and the health of the residents endangered.

It has been found that when sewage is held suspended in a sufficient amount of water in a dark, water-tight and air-tight container for from 12 hrs. to 24 hrs., an action takes place which practically reduces it all to a liquid. A container of this kind is called a septic tank and the action taking place, the septic action, is due to what scientists call "anerobic bacteria"—in common language we call it putrefaction. The liquid discharged from this tank, while clear, is still offensive and must undergo further purification before it can become harmless. This is done by passing it through common farm drain tile and letting it seep out into the ground where another kind of bacteria reduce it further to a harmless liquid.

Concrete lends itself admirablly to the construction of septic tanks since the acids contained in house sewage make steel or even pure ingot iron tanks short lived. Many septic tank designs call for a rectangular tank, long and deep in proportion to the width. This shape is admirably adapted for construction with concrete, while a steel tank of this shape, built strong enough to stand burying in the ground, would be expensive.

Precast septic tanks are within the range of the average products plant and in many instances a ready market products only the necessary awaking of the products promoter and salesman. Following are noted some septic tanks and fittings that have been manufactured and sold successfully.

The septic tank of the E. J. Noblett Manufacturing Co., Chattanooga, Tenn., consists of a monolithic, reinforced concrete, rectangular tank with three compartments. The sewage enters through the soil pipe to the

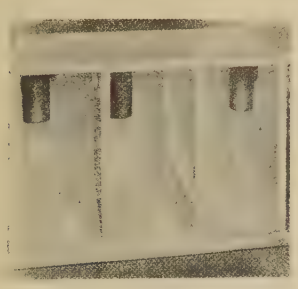


Fig. 1—Septic Tank Manufactured by E. J. Noblett, Chattanooga, Tenn.

first compartment, passes through the opening in the bottom of the partition to the second compartment and then through the pipe at the top of the partition into the third compartment and from there through the outlet to the drain pipe. This tank weighs about 900 lbs. It costs between $25 and $30. It is shipped in two crates. It costs about $45 to $60 installed complete, varying according to distance shipped.

The Perfection septic tank is made up in precast slab units, shipped in sections and set up on the job. A single unit tank installed is 7 ft. 4 in. long, 32 in. wide and 27 in. deep inside. The walls are 2 in. thick. The elbows are 4 in. in dia. The unit weighs 2,800 lbs. It sells for about $75. It is manufactured by the United Cement Products Co., Indianapolis, Ind.

Hygi-sept tanks, manufactured by the Hygiene Products Co., Buffalo, N. Y., are made in one piece, as its producers believe that two-piece tanks settle and break

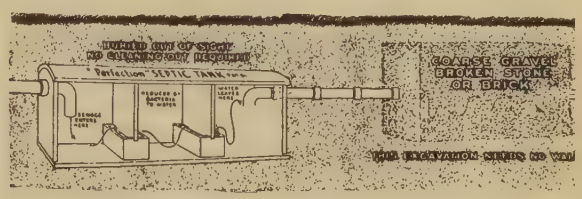


Fig. 2—The "Perfection" Septic Tank, United Cement Products Co., Indianapolis, Ind.

the bond between them. These tanks have a 2-in. wall and are thoroughly coated with Hydrox, inside and out, to make them waterproof. Two types are manufactured, for use with and without running water.

The Sanisep septic tank, shown in Fig. 4, is a reinforced concrete unit with all fittings of reinforced concrete and an integral part of the tank. It embodies no new principle. It is manufactured by the Cement Products Co., Wilmington, N. C.

The Kewanee Private Utilities Co., Kewanee, Ill., after watching the septic action through a glass-walled tank, decided that the successful operation of a septic tank demanded that the scum resting on the top of the liquid should not be broken, that the solid matter in the bottom of the tank should not be disturbed and that the

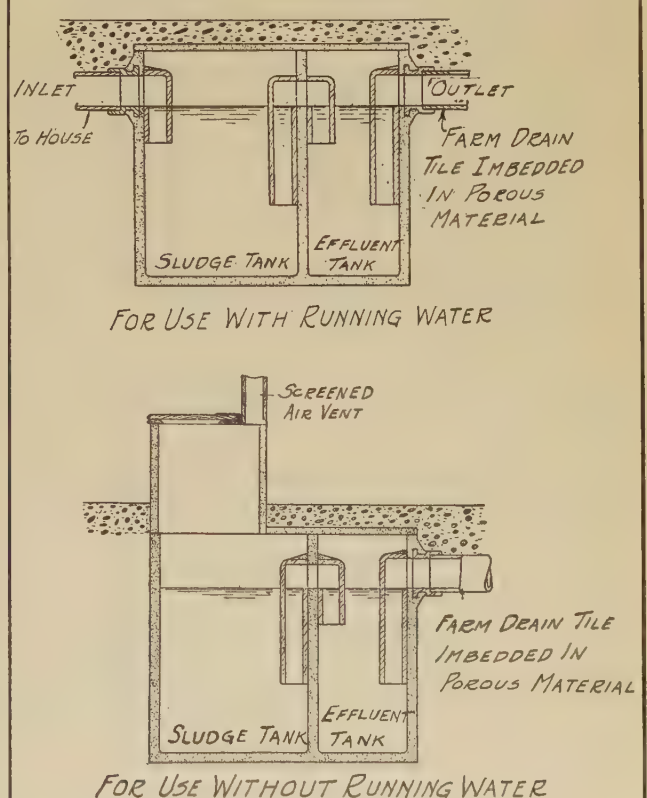


Fig. 3—The "Hygi-sept" Tank, Hygiene Products Co., Buffalo, N. Y.

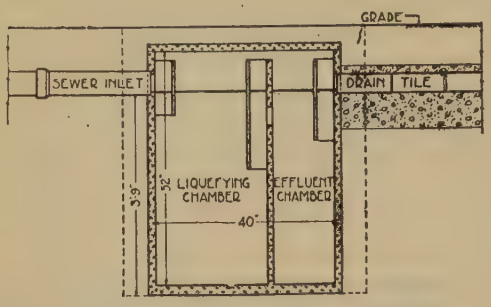


FIG. 4—THE "SANI-SEP" TANK, CEMENT PRODUCTS CO., WILMINGTON, N. C.

flow of sewage through the tank should be regulated. The details of the tank finally produced are seen in Fig. 5. The sewage enters the tank through the soil pipe, horizontally and not downward. This leaves the sludge undisturbed. The sewage is also injected away from the inlet and not towards it. These factors help to spread the sludge evenly over the bottom of the tank. The course of the sewage through the tank is slowed

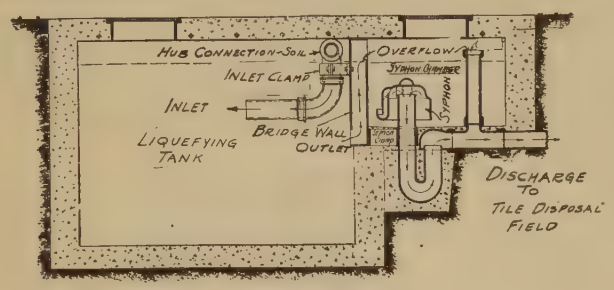


FIG. 5—SEPTIC TANK FITTINGS MANUFACTURED BY THE KEWANEE PRIVATE UTILITIES CO., KEWANEE, ILL.

down by having the outlet eight times the size of the inlet. The air and gases pushed ahead by the sewage escape through a vent in the soil pipe and are not brought into the liquefying chamber. The syphon functions in regulating the flow of sewage from the tank to the drain tile. This prevents partly purified liquid being deposited in the ground at too fast a rate to be taken up and purified.

This tank is poured on the job according to drawings and specifications furnished by the company. The casting that carries the inlet, outlet bridge wall and syphon is shipped adjusted so that it is ready to set in the green concrete. A tank large enough for 10 people is about 9 ft. long x 3 ft. wide x 5 ft. deep.

The Pacific Flush Tank Co. recommends no special

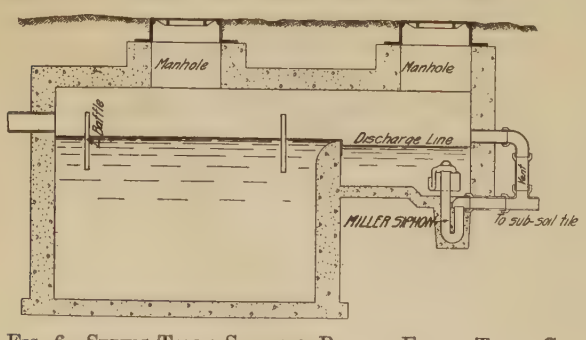


FIG. 6—SEPTIC TANK SYPHON, PACIFIC FLUSH TANK CO., CHICAGO, ILL.

system of tank construction, but manufactures a line of automatic siphons for use in connection with septic tanks. When a siphon is used in connection with such construction a dosing tank or separate chamber is built in connection with a septic tank and the overflow from the septic tank when it rises to a certain height in the siphon chamber is discharged by means of the siphon into subsoil irrigation tile or on to a sand filter. This company claims that if a siphon is not used in connection with septic tank construction and the overflow from the septic tank moves by gravity, there is no distribution of the effluent and the ground where it is discharged is overdosed and usually becomes offensive.

By means of the siphon and subsoil irrigation the contents of the dosing tank are discharged rapidly and distributed over a considerable area. Fig. 6 shows the cross-section of a septic tank equipped with a syphon.

The details of the DeLhorbe septic tank are shown in Fig. 7. Each tank is a complete unit but can be combined with others to increase the capacity of the plant. The tanks are precast and are set in a foundation cast

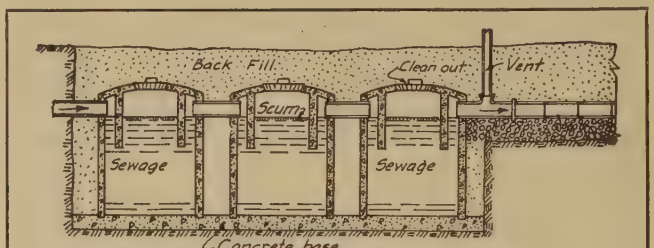


FIG. 7—DE LHORBE SEPTIC TANK

in place. The weight of the tank presses it down into the concrete of the foundation and makes a firm bond. Mr. DeLhorbe gives the cost of manufacturing these units as follows:

6 sacks cement at 60c	$ 5.40
22 cu. ft. gravel	2.00
30 ft. of fencing for reinforcement	1.20
6 hrs. labor at 50c	3.00
Total cost	$11.60

This unit sells at a wholesale price of $42 and retails for $93.33.

William DeLhorbe, Oregon, Ill., manufactures and sells the forms for manufacturing this unit.

An article telling how a septic tank and burial vault business was built up in a small community will appear in an early issue.

Concrete for Mines and Mine Buildings

Some Applications of Concrete in Northern Michigan Iron Mines—Concluding Article—Continued From May CONCRETE

By B. G. Best

Relining No. 2 Hamilton Shaft with Concrete Iron Mountain, Mich.

In 1911 the Oliver Iron Mining Co. decided to enlarge and reline the No. 2 Hamilton shaft at the Chapin mine, Iron Mountain, Mich. This work is described by S. W. Tarr, engineer of construction, Oliver Iron Mining Co., Duluth, Minn., in the 1913 Proceedings of the Lake Superior Mining Institute, from which the following is abstracted:

The original shaft consisted of six compartments, and was lined with 16 in. by 16 in. timbers, spaced 6 ft. 2½ in. center to center, with wood studdles and steel hanging bolts. The shaft was lathed with 2-in. plank. The outside dimensions were 10 ft. by 24 ft. 4 in. To provide for column pipes and transmission cables it was necessary to increase the inside dimensions of the shaft from 7 ft. by 21 ft. 4 in. to 9 ft. by 21 ft. 4 in. The relined shaft, with 6-in. poured concrete walls, and precast reinforced concrete dividers and end pieces, has eight compartments, and required no more excavation than the old timber shaft. Between the cage and skip compartments, pipe and skip compartments, and ladder and skip compartments are concrete slab partitions. Fig. 29 shows the old and new shafts, and Figs. 30 and 31 sections of the concrete shaft.

The dividers, end plates, and slabs, of 1:2:4 concrete, are cast in steel forms on surface near the shaft. Fig. 32 shows the concrete dividers, and Fig. 33 the sub-dividers and slabs.

The work of relining the shaft was done in sections, working upwards from permanent bearers located to support the timber sets. A section of old timber, usually 12 ft., was removed and hoisted to surface. The timber above the section removed was supported by vertical columns set on jack screws, resting on 12 in. by 12 in. timber placed on the bearers. After the first 6-ft. section of concrete was poured, the 12 in. by

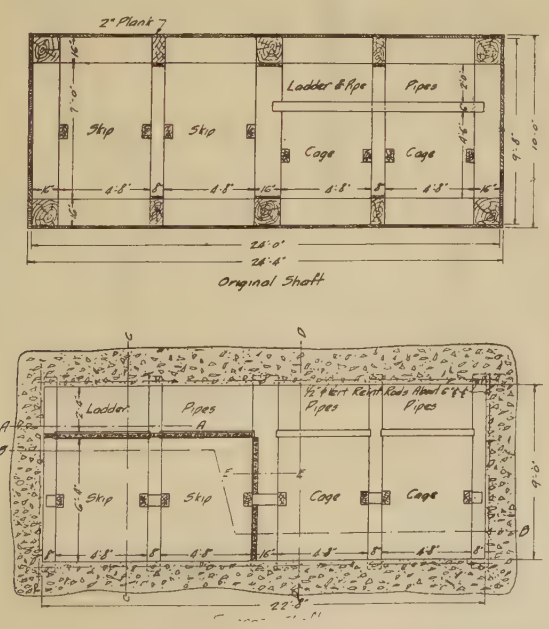


Fig. 29—No. 2 Hamilton Shaft, Oliver Iron Mining Co.—Sectional Details

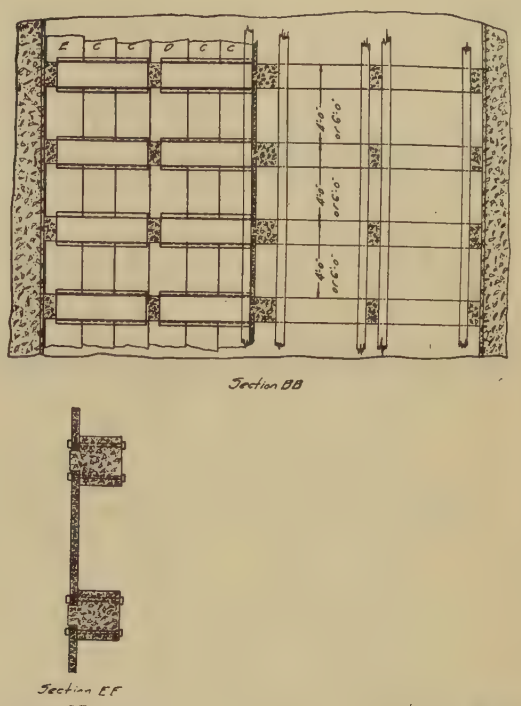


Fig. 30—No. 2 Hamilton Shaft, Oliver Iron Mining Co.—Sectional Details

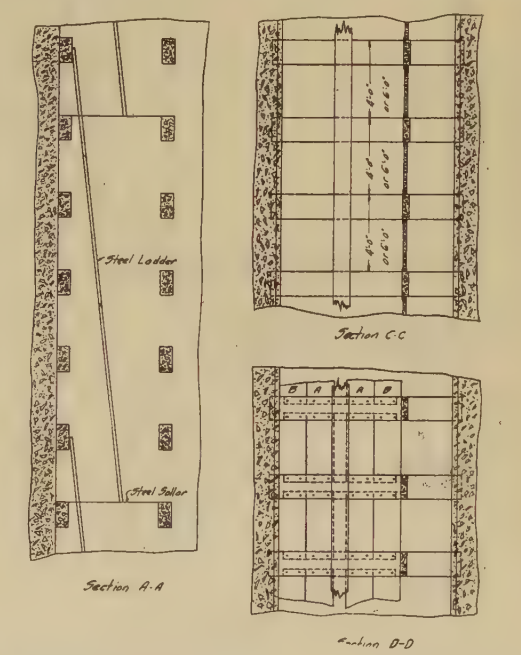


Fig. 31—No. 2 Hamilton Shaft, Oliver Iron Mining Co.—Sectional Details

12 in. timbers were placed on the reinforced concrete dividers and end plates, as shown in Fig. 34. The wall forms were made of steel, in sections, with recesses to support end plates and dividers spaced either 4 or 6 ft. center to center. Seven sets of steel forms were used, so that the weight of the old timber sets was carried by permanent bearers or distributed over at least five sets, or 30 ft., of concrete, and no weight was placed on green concrete. After the sections of the steel forms, 6 ft. high, were installed, the concrete dividers and end pieces were lowered and placed in the recesses in the forms, and the ends bolted to the forms. The end pieces and dividers served as horizontal struts to hold the forms in position. Vertical reinforcing rods were then placed and the concrete poured. The concrete for the walls was mixed on surface and loaded into side dump steel cars, which were run on to a cage in one of the skip compartments and lowered into the shaft. Two cages were used, one in each skip compartment. A revolving chute was attached to the spout of the car, and the concrete discharged behind the forms and properly tamped.

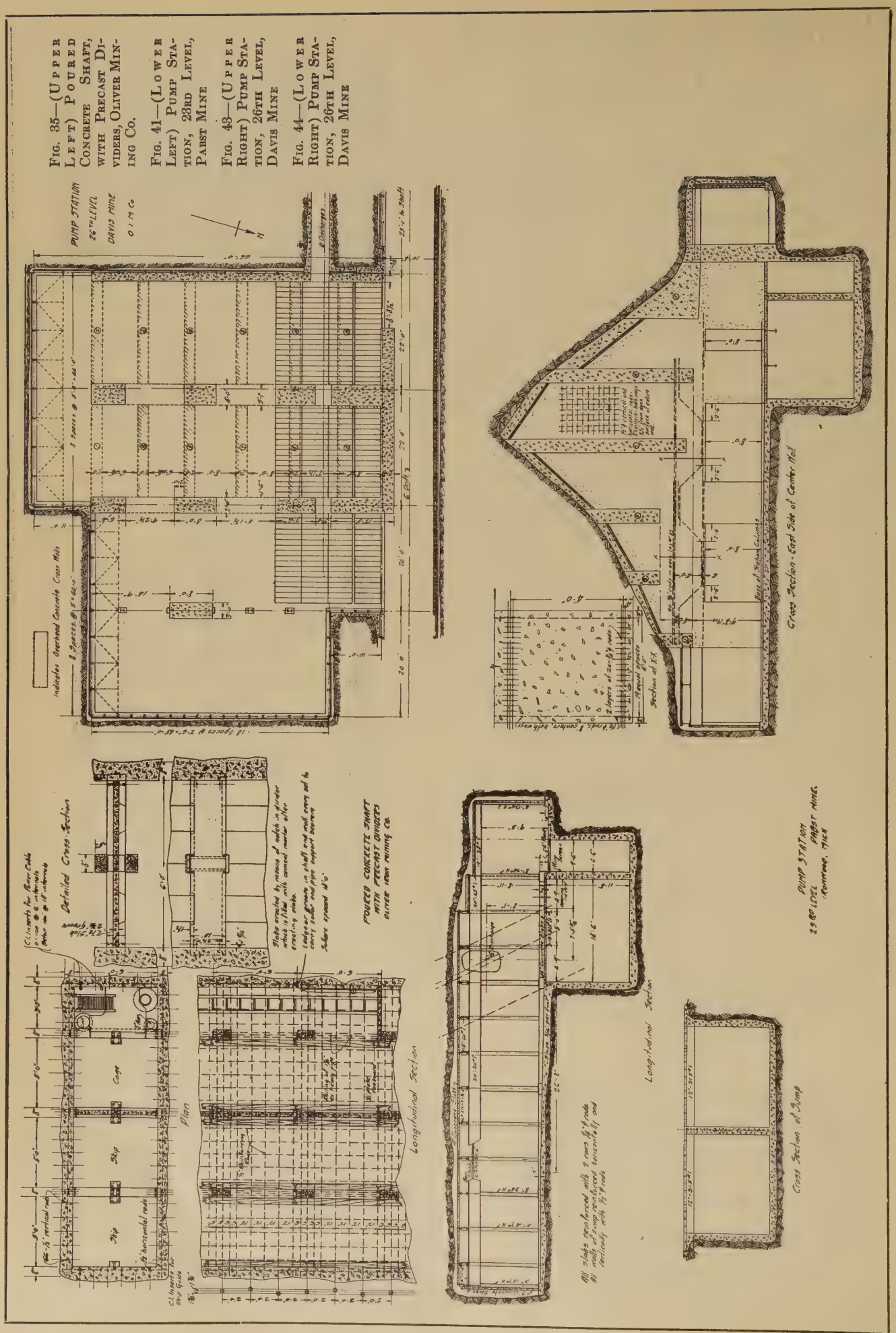


FIG. 35—(UPPER LEFT) POURED CONCRETE SHAFT, WITH PRECAST DIVIDERS, OLIVER MINING CO.

FIG. 41—(LOWER LEFT) PUMP STATION, 23RD LEVEL, PABST MINE

FIG. 43—(UPPER RIGHT) PUMP STATION, 26TH LEVEL, DAVIS MINE

FIG. 44—(LOWER RIGHT) PUMP STATION, 26TH LEVEL, DAVIS MINE

Where large crevices occurred in the rock they were filled to within 10 in. of the forms with large rocks before the concrete was poured.

Five men in the shaft and one on surface were required to remove the old timber. Four men in the shaft and two on surface lowered and placed the forms. Four men in the shaft and two on surface poured the concrete. These six men, with a shaft foreman and a concrete foreman, constituted a crew. Three eight-hour shifts were worked, in which a 6-ft. section of shaft was completed.

The first section of the shaft to be relined was from a point 83 ft. 3 in. below the collar to surface. The second section started 302 ft. 7 in. below surface, the third 551 ft. 3 in., the fourth 695 ft. 7 in., and the fifth 917 ft. 4 in. The average section was about 183 ft. 6 in.

The average rate of progress for the first 812 ft., without deducting time due to delays, was 56.6 ft. per month, or 63 ft. per month for actual working time.

Poured Concrete Shaft, Riverton Mine, Iron River, Mich.

Fig. 35 shows a poured concrete shaft, with precast reinforced concrete dividers, recently completed to a depth of 1,260 ft. by the Oliver Iron Mining Co., at the Riverton Mine, Iron River, Mich. The minimum thickness of the concrete walls is 8 in. The walls are reinforced vertically with sixty-six ½-in. round rods, and horizontally with ½-in. rods spaced 6 in. apart at the dividers and 12 in. apart between sets. Precast dividers, 8 in. by 15 in. are spaced 6 ft. center to center. Two

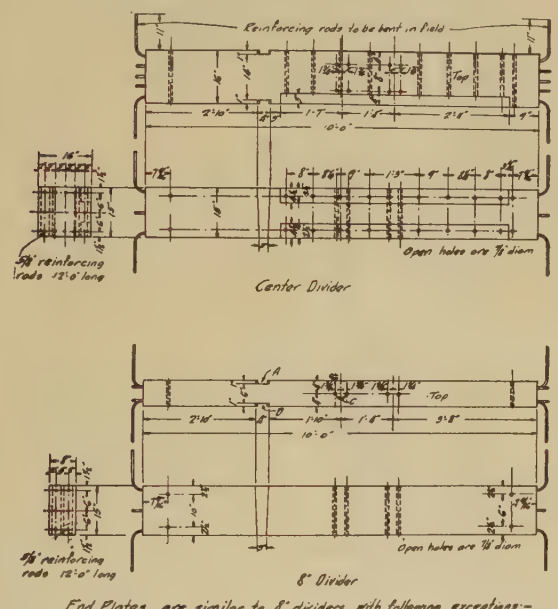

Reinforcing rods to be bent in field
Top
Open holes are ⅞" diam
⅝" reinforcing rods 12'-0" long
Center Divider
Top
Open holes are ⅞" diam
⅝" reinforcing rods 12'-0" long
8" Divider
End Plates are similar to 8" dividers with following exceptions:-
Right End Plate — Omit notch A and holes C
Left End Plate — Omit notch B only
Mixture 1:2:4

Fig. 32—No. 2 Hamilton Shaft, Oliver Iron Mining Co.—Details of Main Dividers

notches were left in each divider, opening into the groove in which the slabs were placed, and through which the slabs were inserted. After the slabs had been placed the notches were filled with cement mortar. Slabs were placed between the cage and skip roads only. Ledges were left in the shaft walls to support reinforced concrete collars, spaced 18 ft. apart. The cast iron inserts and guide connectors are shown in Fig. 35.

No. 3 Shaft, Negaunee Mine, Negaunee, Mich.

One of the best examples of a circular concrete shaft in northern Michigan is No. 3 shaft, Negaunee mine, of the Cleveland Cliffs Iron Co., at Negaunee, Mich. S. R. Elliott, general superintendent of the Cleveland Cliffs Iron Co., at Ishpeming, Mich., has described this shaft in the 1912 Proceedings of the Lake Superior Mining

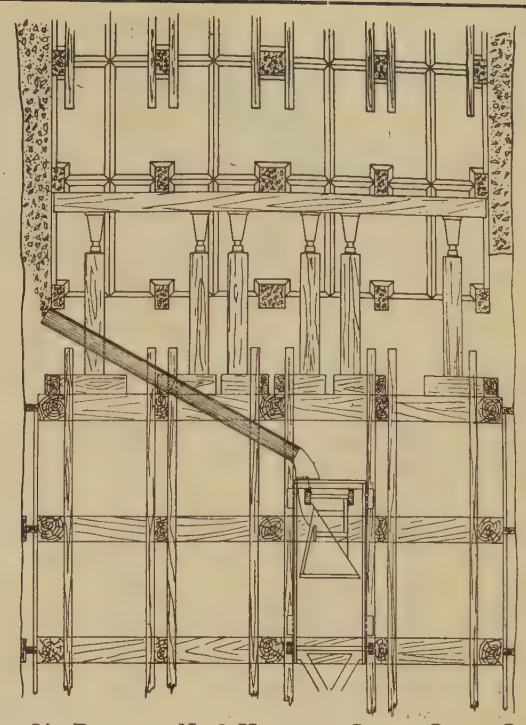


Fig. 34—Relining No 2 Hamilton Shaft, Oliver Iron Mining Co.

Institute. An abstract of his paper, "The Method of Raising, Sinking and Concreting the No. 3 Shaft, Negaunee Mine," follows:

After determining the location of the shaft on surface, a test pit was sunk through 68 ft. of sand and hardpan to the ledge. A cribbed raise was started from a drift 806 ft. below surface and continued to within 5 ft. of the bottom of the test pit. The cribbing was removed and the raise blasted through to the bottom of the test pit. The sand near the top of the raise was removed by a derrick, leaving a conical shaped hole. At a point 40 ft. below the original surface a hexagonal wooden shaft was built, 24 ft. inside diameter. The sets were spaced 5 ft. apart and 3-in. plank spiked to the outside. The alternate planks were cut 5 ft. 6 in. and 11 ft. long. These served to tie the adjacent sets together, making the structure quite rigid and preventing it from getting

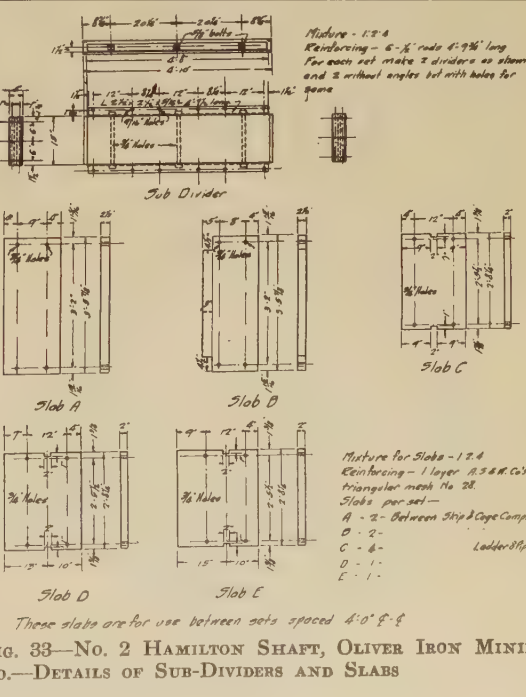
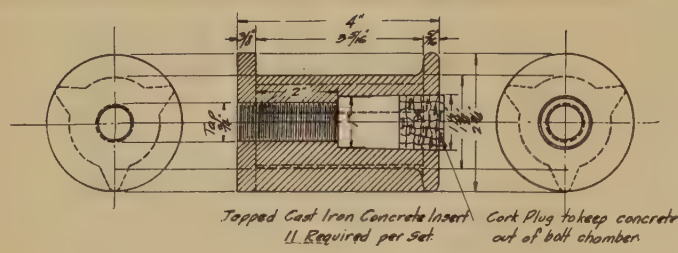

Mixture - 1:2:4
Reinforcing - 6-⅝" rods 4'-9½" long
For each set make 2 dividers as shown and 2 without angles bet with holes for same
Sub Divider
Slab A
Slab B
Slab C
Slab D
Slab E
Mixture for Slabs - 1:2:4
Reinforcing - 1 layer A.S.&M. Co's triangular mesh No. 28.
Slabs per set—
A - 2 - Between Skip & Cage Compts
B - 2 -
C - 4 - Ladder Pipe
D - 1 -
E - 1 -
These slabs are for use between sets spaced 4'-0" C-C

Fig. 33—No. 2 Hamilton Shaft, Oliver Iron Mining Co.—Details of Sub-Dividers and Slabs



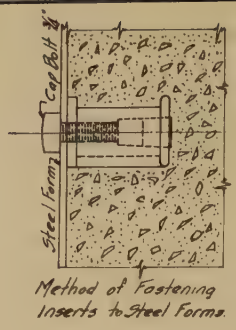


FIG. 36—CONCRETE INSERT FOR POURED CONCRETE SHAFT, OLIVER IRON MINING CO.

out of line. The shaft was allowed to drop slowly to the ledge as the material below was excavated.

The permanent shaft was circular lined with 1½ ft. of concrete, and with an inside diameter of 17 ft. The shaft contains a cage compartment, two skip compartmnets, a ladder compartment, and four smaller compartments which can be used for pipes, counterweight, electric transmission lines, and the like. The plan of the shaft is shown in Fig. 37.

From the conical hole around the test pit a 12-ft. cut was made to a nearby gravel pit and track put in. Four feet below this track two pockets were built, the capacity of which was 35 yds. These pockets were provided with chutes from which the gravel could be drawn into a small car holding the exact amount for a charge. This car dumped into the hopper of a batch mixer, which was at a still lower elevation. Below the mixer the concrete was dumped into a bucket, which rested on a small truck. This truck could be pushed to the center of the shaft, the bucket attached to the hoisting rope, and lowered, and the concrete dumped into the forms. The crew of five men on the surface could easily handle 35 yds. of concrete in an eight-hour shift, or enough to complete 10 ft. of shaft. The water was heated by exhaust steam and measured for each batch of concrete. The cement house was located close to the edge of the conical hole and a slide built from one end of the house to the elevation of the hopper of the mixer. The bags of cement were thrown into the slide until it was full, and as one bag was removed another would slide into its place. The general arrangement is shown in Fig. 38.

The raise was stripped in multiples of 10 ft., and the length of sections varied from 20 ft. to 90 ft. After each blast the entire section was examined and carefully trimmed. If it could not be trimmed solid, stripping would be discontinued and preparations made to commence concreting. The length of sections was made as great as possible to save time in changing from one operation to another.

The concrete forms consisted of rings 5 ft. high and 17 ft. in diameter, made in four sections, so that they would be collapsible. They were properly braced on the inside to withstand the pressure of the concrete. When a section had been stripped the engineer would locate the elevation for the bottom of the first form. The procedure was to put in a number of short pieces of timber (*A*, Fig. 39) around the collar of the raise, and level them properly, to form a base for the floor upon which the forms rested. The floor (*B*, Fig. 39) was made out of 2-in. hardwood plank, 7 ft. long, sawed on a radius of 10 ft. When the floor was laid on the blocking, the ends of the plank being shoved up against the irregular wall, it completely covered the circumference. The small openings next to the rock were filled with short pieces of wood to keep the concrete from running through. To remove the floor without cutting any pieces, one of the plank (*C*, Fig. 39) was laid

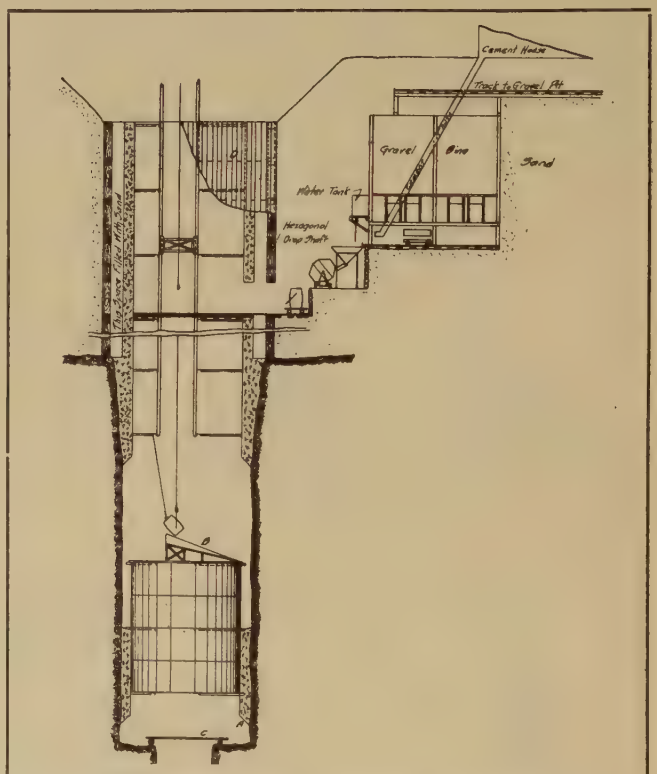


FIG. 38—GENERAL VIEW CONCRETE EQUIPMENT NO. 3 SHAFT, NEGAUNEE MINE

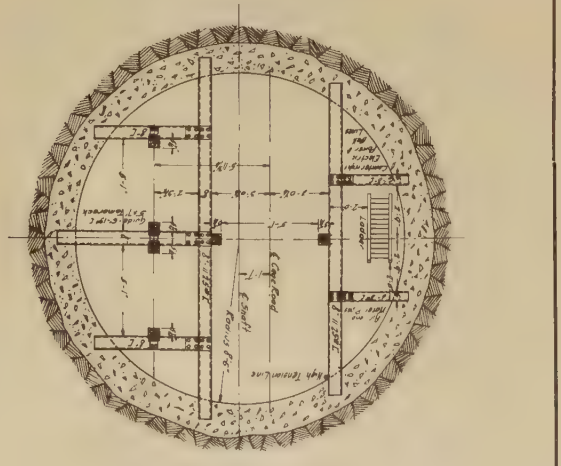


FIG. 37—NO. 3 SHAFT, NEGAUNEE MINE

with the wide end toward the center of the shaft. This was easily pulled out and the others came freely. The first form lowered was a special one to cut off the lower face of the concrete at an angle of 45°. A regular 5-ft. section was next lowered and bolted together, and placed in position by plumb lines dropped from above. The steel sets were then lowered and placed accurately in position and attached to the forms by clamps. Recesses were made in the top of two of the forms, so that the top of the sets would be flush with the top of the forms, their ends extending about a foot into the walls. The trough (*B*, Fig. 38) was next placed in position. This extends from the center of the shaft to the edge of the forms, the outer end being about 2ft. lower than the part in the center of the shaft. A bucket containing ½ yd. of concrete was then lowered, and dumped as shown in Fig. 38. After the first 5 ft. had been concreted, 10 ft. additional of forms were lowered and placed in position, and a shaft set placed as before. Forty-eight hours after the concrete had been poured the forms of the lower section could be removed.

The raise was covered by a strong platform about 12 ft. square. Wire ropes extended from the four corners to a hook in the center, which could be attached to a ring in the

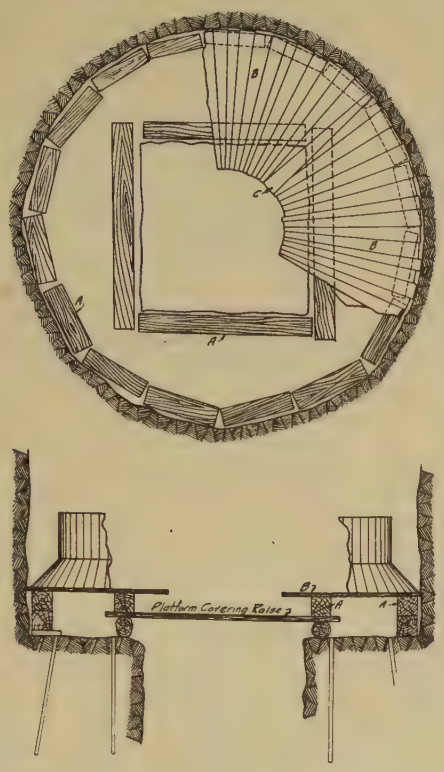


Fig. 39—No. 3 Shaft, Negaunee Mine

bottom of the bucket, and the platform raised or lowered as was desired.

The joints between the sections of concrete were filled with rich mortar, and although the shaft is not absolutely waterproof, the water that does seep through the walls is not enough to cause any trouble.

Concrete stations and concrete pockets and measuring hoppers were used in this shaft.

Underground Pump Stations—"G" Pabst Pump Station

Concrete was used extensively in three underground pump stations recently built by the Oliver Iron Mining Co. on the Gogebic Range. On the 23rd level, Pabst mine, Ironwood, Mich., the company built a steel and concrete pump station to house two electrically operated pumps, each having a capacity of 300 gals. per minute against a static head of 1,625 ft. The pump house proper is 39 ft. wide, 59 ft. long, and 12 ft. 2 in. high, outside measurements. The sump, however, extends 4 ft. 6 in. under the drift, running past one end of the pump house to the shaft. (See Figs. 40 and 41.) Three sides and the roof of the pump house are of precast reinforced concrete slabs, supported by steel frame work. From the pump house to the shaft the drift is lathed with similar slabs on steel sets. The piers for the steel columns, the floors, sump walls, and floor, and machinery foundations are of concrete. The sump is 20 ft. by 29 ft. by 12 ft. deep, and is divided into four compartments by 12-in. concrete walls. Two of the compartments are 14 ft. by 14 ft. 6 in., and the other two, those under the drift, are 4 ft. 6 in. by 14 ft. All walls of the sump are reinforced both horizontally and vertically by ½-in. diameter rods. The horizontal rods are spaced closely at the bottom of the walls and farther apart in the upper part. The sump is covered with 4-in. concrete slabs, reinforced with two rows of ¼-in. rods, and supported on the walls of the sump and on two 12-in.—31.5 lbs. I-beams extending across the two larger sump compartments. The wall columns of the pump house are 5 in.—18.7 lbs. H-sections, spaced 5 ft. center to center, and resting on a concrete base which extends around three sides of the pump house. In the center of the pump house, spaced 15 ft. apart, are four 8-in.—34 lbs. H-section columns on concrete piers. Supported on these columns and running from one end of the pump house to the other are 20-in. 80-lb. I-beams. These 20-in. beams and the 5-in. wall columns support 15-in. 60-lb. I-beams extending across the pump house and supporting the roof slabs. These slabs are 4 in. thick, precast, and reinforced with two rows of ¼-in. rods. The walls of the pump house are lathed with 3-in. precast slabs, similarly reinforced, placed outside of the wall columns. At two corners near the drift poured concrete is used in place of the wall slabs. The floor is of concrete and slopes toward the sump. The posts of the drifts set are 4 in.—13.6-lb. H-sections and the caps 10-in.—25-lb. I-beams. The sets are spaced 5 ft. apart. The sides are lathed with 3-in. precast slabs, and the roof with 4-in. slabs. Bus bar compartments of reinforced concrete were built in one end of the pump house.

Fig. 42 is an interior view of one corner of the pump house, and shows the bus bar compartments, steel framing and concrete lath. Cement and sand were sent down from surface in bags. Washed mine rock was used for the coarse aggregate, and the concrete mixed in an air-driven mixer in the pump house. The slabs were made in the same plant that was used in making lath for the shafts, and were lowered on the cage.

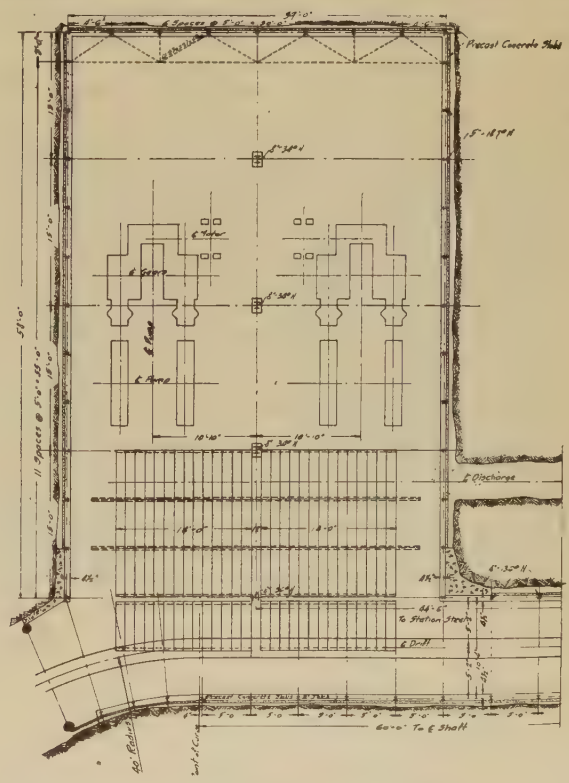


Fig. 40—Pump Station, 23rd Level, Pabst Mine

The Norrie pump station is larger than the Pabst station, the maximum dimensions being 59 ft. by 75 ft. In this pump house are installed three electrically driven 400-gal. pumps. Except for the difference in size, the two stations are similar in design and construction.

Davis Pump Station

It was planned to build a similar station on the 26th level of the Davis mine, but in making the excavation for the main part of the pump house two faults were

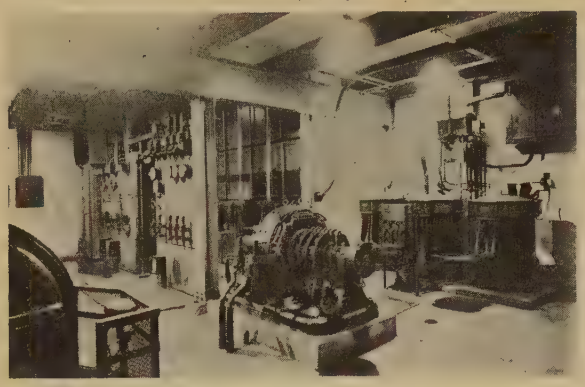


FIG. 42—INTERIOR VIEW, PABST PUMP STATION, SHOWING STEEL AND CONCRETE CONSTRUCTION AND CONCRETE BUS BAR COMPARTMENTS

encountered which intersected at a point 38 ft. above the base of the station columns, or about 29 ft. above the proposed maximum height of roof. With nothing to support it, the rock below the intersection of the faults fell, between 1,200 and 1,500 cu. yds. of broken rock coming down. Since the rock was slate and would continually spall off, it was considered inadvisable to proceed with steel construction, and the concrete construction shown in Figs. 43 and 44 was decided upon. Three reinforced concrete walls were built under the caved portion. The first wall was along the west side of the pump house and was 1 ft. 6 in. thick. In the center was a 4 ft. wall, and on the east side of the cave a 3-ft. wall. Between these walls were overhead cross walls of reinforced concrete, extending up to the solid rock. Fifteen-inch I-beams extended between the cross walls near the rock and acted as rafters.

Seven I-beams were placed between the odd numbered cross walls, and eight between the even numbered walls. Supported by the I-beams and filling the space between them and the roof was a reinforced concrete roof slab, cast in place. The roof of the eastern part of the pump house was not damaged by the cave. In this part precast concrete roof slabs were used, supported by 23 15-in. I-beams extending from the 3-ft. wall to the steel wall columns on the east side of the pump house and supported in the middle by a 20-in. I-beam carried on the steel and concrete columns.

So that the pumps could be installed, it was necessary to leave openings in the cross walls. Fig. 44 shows the reinforcing over the openings in the 4-ft. wall—four rows of twenty ¾-in. round rods being used. The 3-ft. wall was reinforced in a similar manner with four rows of fourteen ¾-in. rods. Both surfaces of the 3-ft. and 4-ft. walls and the east surface of the west end wall were reinforced with ½-in. vertical and horizontal rods spaced on 8-in. centers 2½ in. from the surfaces of the walls. The main reinforcement in the cross walls consisted of twenty-three ¾-in. rods in two rows. The walls were reinforced horizontally and vertically with ½-in. rods on 15-in. centers and 2 in. from the surface. The minimum depth of the cross walls was 6 ft. In order to give the necessary clearance for the machinery it was necessary to reduce the depth of No. 4 cross wall and to increase the reinforcing to three rows of ¾-in. rods in the bottom, containing 28 rods, and 4 ft. above this two rows of ¾-in. rods containing a total of 15 rods. Forms for the roof slab were made by placing plank on the lower flanges of the I-beams. The reinforcing was ½-in. rods laid between the I-beams and spaced 10 in. on centers. The space between the planks and the rock was filled with concrete.

The method used to protect pipes from the action of sulphuric acid contained in mine water is described in *Skilling's Mining Review*, from which the following is abstracted:

The Oliver Iron Mining Co. has caused all of the pumps and column pipes in its Riverton group of mines, at Stambaugh, Mich., to be lined with concrete to protect them from the acid waters of those properties. A weak solution of sulphuric acid is created by association of the water with pyrite, and the effect upon the equipment is destructive. This has been overcome by lining it with concrete.

The Riverton iron mines consist of the Dober, Isabella and Duff leases. The two old production shafts which have served the properties are about to be supplanted by the new No. 3 shaft, a 5-compartment opening, which will soon go in commission. Preparations for putting it in use are now nearly completed. The shaft is lined with concrete.

How Pipes Were Lined

Following is a detailed description of the method employed in lining column pipes with concrete for shaft No. 3 at the Riverton mines:

A timber trestle was built having a working platform 19½ ft. above ground, and a beam trolley track supported 16 ft. above the working platform carrying a rope or chain block with which column pipes, core pipes and concrete material were handled in the various parts of the operation. Before setting up, inside of column pipe was cleaned thoroughly of all dirt, scale and oil. Along the central part of the platform a long hatchway was provided. Directly below the hatchway a sill was set about 2½ ft. above ground. The 8-in., 18-ft. column pipes were then stood on the sill with top projecting about a foot above working platform. Pipes were secured vertically by two pairs of wood strips; one pair laid across the hatchway and secured by pins droped into holes in strip and corresponding holes in floor, and a second pair laid across the first and secured by loose pins in same manner.

Pipe cores were made from 6-in. extra heavy pipe about 10 ft. long, turned smooth on the outside and tapered from 6 3-16 in. diameter at the lower end to 6⅜ in. diameter at 9 ft. above lower end. In upper end of pipe was coupled a pipe plug, in center of which a hole was drilled and swivel eyebolt connected. Pipe cores were cleaned and wiped each time after using with a mixture of one part linseed oil and one part kerosene oil, to prevent rust and adhesion of concrete. Pipe core was lowered into top of column pipe until lower end rested on a centering cone and stop plate set inside the column pipe to seat core at mid-length point.

Stop plate and centering cone consisted of a small pipe seated in a pocket in the wood sill and having welded in its uper end a threaded stub with nut. On the stub above the nut was a plate disc slightly smaller in diameter than inside of column pipe. On top of the disc was placed a gasket large enough to form a close seal against wall of column pipe. On top of gasket was screwed a truncated cone with a short cylindrical section at the base, which had a diameter slightly less than inside diameter of core pipe, so that core pipe was positively centered and held in position.

The column pipe at its base was secured to the sill by dropping two pins through diametrically opposite holes in the pipe flange. The lower end of stop plate support was dropped into a pocket about 1 in. deep, which centered it inside the column pipe at this point. The pipe core was centered at the top by means of three wooden wedges left in place until pouring of concrete was nearly completed.

Concrete for Pipe Lining

Concrete for pipe lining was composed of one part Universal portland cement to 1½ parts clean sharp sand, passing through a ¼-in. screen and free from loam, clay and vegetable matter.

Materials for concrete were hoisted to working platform and mixed by hand as required for use.

Concrete was poured into upper half of pipe, compacted by light hammering of pipe walls and rammed thoroughly with steel rods as filling progressed. When the pouring was nearly completed, the centering wedges were removed at the top, and concrete finished smooth and even with flange of pipe.

When linings were poured at an average outside temperature of 60° F., pipe cores were carefully loosened two hours after pouring, turned and raised an inch and allowed to settle back to rest. At intervals of one hour cores were turned and raised slightly and removed about eight hours after pouring.

As soon as concrete lining hardened sufficiently to handle

safely, column pipes were slung at center of gravity, lowered to clear working platform, ends reversed and pipe then set up again for installing lining in the other half.

After thoroughly washing end of lining at center of column pipe, the core was lowered and carefully inserted an inch into finished lining, and centering wedges driven at the top. The second half of the lining was then poured in the same manner as the first half.

In this work for the Riverton mine 12 lengths of column pipe were set and in process of lining at one time. Each 18-ft. length of pipe required 24 cu. ft. of concrete weighing about 370 lbs. The concrete in these pipes was approximately ⅞ in. thick.

Conclusion

As previously stated the object of this article is not to cover the entire field of concrete construction in mining operations. The examples given have been selected with the idea of illustrating the different types of construction and to show how concrete has been used in mine buildings, miscellaneous surface structures, headframes, shafts, and pump stations. These examples will perhaps suggest many other applications which have not been mentioned. Neither has any mention been made of the cement gun, which as been used with satisfactory results in many ways in mining. A discussion of the uses of gunite, which in a way would parallel the the uses of concrete, would make this article entirely too long.

Concrete has many advantages over timber and steel in mine construction. First of all, it is fireproof, which is of paramount importance in mining. It is permanent and will neither decay nor corrode. Concrete buildings are also vermin proof, and are easily heated and kept at a uniform temperature. Waste rock from mines can be used in concrete construction, and the regular mine crews are capable of handling the material. Because of these advantages concrete has come to occupy a position in the field of mine construction equal to that of steel. That it will continue to hold this position there is no doubt. The only question is: What are the limits to the uses of concrete in mining?

Fireproofing Old Mill Construction Warehouse With Reinforced Concrete

By Walter H. Wheeler
Consulting Engineer, Minneapolis

To eliminate waste is one of the aims of our modern industrial plants. Waste has been one of the sins of America. Efforts are now being made to reduce to a minimum the waste that is necessary in construction operations. Less thought has been put upon using old structures and increasing their life by remodelling into modern buildings. It is much easier to tear down the old and build new, and such a scheme naturally appeals more to the architect and contractors, unless the owner insists on some other course.

It is frequently possible to remodel an old building into a fireproof building, which, for all practical purposes is substantially as good as a new building, and by so doing, save the owner a large sum of money on his investment. This was true in the case of a four-story warehouse building in Spokane, Washington, which was made over, from a timber mill construction building, into a modern fireproof reinforced concrete warehouse building, with floors designed to carry 400 lbs. per sq. ft. live working load, in the fall of 1916.

The old walls of this building were stone and brick and were for the most part in good condition. They rested on solid rock foundation. The old story heights were 11 ft. 7 in., floor to floor, except the top story, which was about 12 ft. average height, with pitched roof. The old floors were of wood joist, wood beams, and wood posts, with wood sheathing and flooring for the surfaces.

The new floors and roof are reinforced concrete, Spiral Mushroom system flat slab, with standard column capitals, and without depressions over the columns. New concrete footings were placed to receive the new columns, with dowels to the columns. The column spacing was made 19 ft. 6 in. by 18 ft. 6 in., which permitted the new columns to pass through the old wooden floors without interfering with the old posts or girders. New

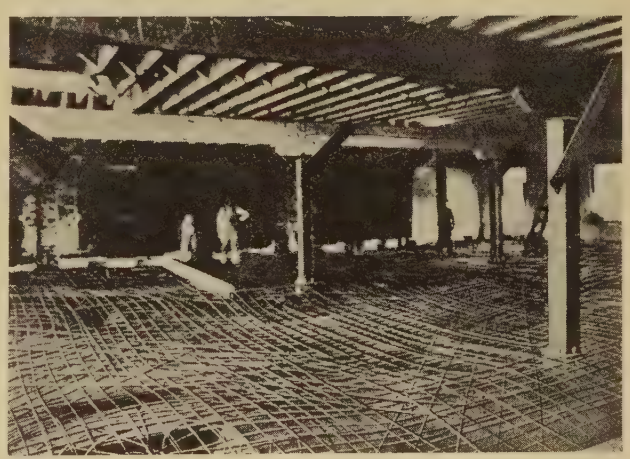


Fig. 1—Remodelling Mill Construction Warehouse into a Fireproof Warehouse, with Reinforced Concrete Floors and Columns, Spokane, Wash.

Reinforcing for the third floor in place, ready for pouring the concrete, using the old wood floors for the forms.

columns were placed against the inside face of the walls, except at the corners of the building. The slabs are notched into the old walls to give bearing of 9 in. on two sides of the building, the notches being two bricks long, with spaces one brick long between left undisturbed. On these two sides there is a concrete fillet between the slab and the inner face of the walls. On the other two sides of the building the slabs are also notched into the walls in a similar manner to tie the walls into the floor construction, but the slab load is carried by beams between columns and placed just within the walls. At the corners of the building, where there are no columns, these beams are supported on the walls. Beams were used on these two sides, be-

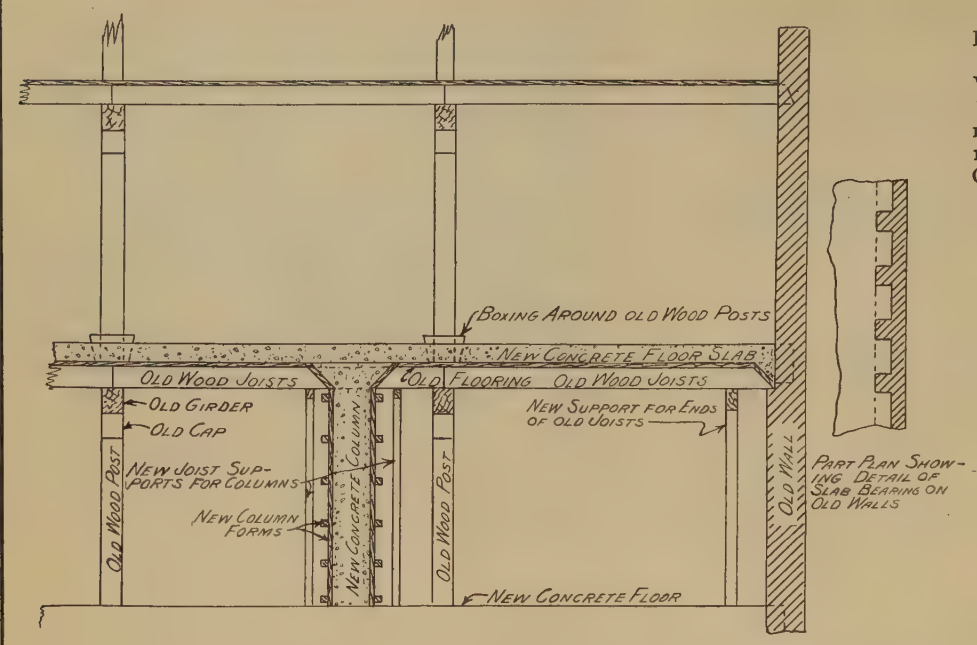


Fig. 2—Sketch of Part Cross Section of Pittwood Warehouse, Showing How Mill Construction Building Was Converted to Reinforced Concrete Fireproof Construction

cause the walls were not as heavy and there were more openings in the walls, so it was considered desirable to relieve the walls of the floor load.

In executing the work, the necessary openings were made in the old floors for the column capitals, and the floor cut out where new beams are located, the new column forms and beam forms erected, and the steel laid on the top of the old wooden floor. The old floors made the forms for the new concrete floors, which were poured as usual from the bottom up to the roof. It was only necessary to make the slight alterations in the old floors above mentioned and put in the necessary new form work. Boxes were placed around the old wood posts, as shown in Fig. 2, with sloping sides to leave openings in the new slabs smaller at the bottom than at the top. After the concrete work was in place and cured, the old floors were removed from the building. From this point on to completion of the building there was nothing unusual about the work. The holes in the slabs left by the old wooden posts were filled with concrete, and the cement finish applied in the usual manner.

The net result was a modern fireproof building, with the column floors and roof of reinforced concrete, and the cost was very much less than the cost of a new building.

The lumber in the old floors was practically undamaged by the reconstruction, so that the salvage was about the same as though the building had been wrecked. The cost of forms was of course very small compared with the form work for a new building.

The success of the operation depended upon selecting the type of reinforced concrete construction, which would require the least cutting of the old floors and roof and using the old floor levels as they were. A construction which required depressions on the columns, or a beam construction, would, of course, have increased greatly the cost of the form work, and depreciated the value of the lumber for salvage. The salvage of the lumber is an important item at prices which have prevailed in recent years.

Fred Westcott, Spokane, was the architect, and the writer was designing and consulting engineer, represented by Philip Kennedy on the ground. Construction was by day labor.

A Conveyor Loader Used for Stocking Stone

When there has been an uncertainty about future shipments of stone for use in building concrete highways, Winston & Co., contractor, Hughesville, Pa., puts a conveyor loader to work stocking stone in advance of concreting. The elevator used is a No. 9¾, 30 ft. c. to c., manufactured by the Acme Road Machinery Co., and is

Stocking Stone for Concrete Road Work at Picture Rocks, Pennsylvania

operated by a 10 h. p. upright gasoline engine. The conveyor is one manufactured by the Koehring Co., primarily for the purpose of delivering aggregates from the subgrade to the concrete mixer on paving work. The machine is supported on a cribbing of railroad ties, which was added to as the pile of stocked stone increased in height. The contractor says that it is possible to stock about 50 tons of stone an hour with this equipment.

Among the oldest reinforced concrete structures in the United States are the Museum Building, Leland Stanford University, Palo Alto, Cal.; girls' dormitory building, at the same university; U. S. torpedo magazine, Goat Island, Cal.; Pacific Coast Borax Works, Alameda, Cal., and a small bridge in Golden Gate Park, Cal. These structures were built in the period of about 1890 by Ernest Ransome, using his patented square twisted bars for reinforcement.

In 1892 or 1893 the Graystone Hotel at Johnston Park, near Delaware Avenue, Buffalo, N. Y., was built by Carlton Strong, architect. This five-story building is still in service and seems to be in perfect condition.

In 1894 a small reinforced concrete arch bridge was built at Cedar Rapids, Ia.

Small Units in House Building

Roofs for Concrete Houses —Sixth and Final Article

By A. J. R. Curtis
Chicago

In a preceding article of this series, which appeared in Concrete for January, various concrete building units were shown and described. Unforunately it was impossible at that time to include a few of the later types of units, on which the desired data had not been received, so these have remained to be treated specially in the present article. All the systems about to be described fall under the classification of concrete building tile. Each varies in design and other important characteristics from all of the other blocks and tiles.

Perhaps one of the most original of the building tile system is known as the Duntile, being made on an ordinary Dunn drain tile machine equipped with square jackets. It is the only building tile made by the packer-head method of ramming ordinarily used in drain tile manufacture. Placed horizontally in the wall, it gives horizontal air cells possibly of some advantage in avoiding convection currents. Since ordinary joints, even when made of a portland cement mortar, are in some instances 25% to 40% weaker than the individual concrete units joined, Duntile has been designed to give a mortar bearing area proportionately greater than the thickness of the block web. Corners and specials for this system are now being introduced. Full size tile are all 12 in. long. Three sizes have 4 by 4 in., 6 by 6 in., and 8 by 8 in. sections.

Ideal wall tile is a well planned adaptation of the Ideal two-core block, so far as general shape is concerned. It has the advantage of simplicity of design and is easy to handle any way it is picked up. Some Ideal machines now in use can be equipped quickly to make the new units. Ideal tile sizes run 5 by 4 by 12, 5 by 8 by 12, and 5 by 12 by 12, as laid up in the wall. The Acme system, while showing a certain similarity of the regular block system, has an extremely ingenious interlocking arrangement which tongue-and-grooves every unit into those surrounding it. Standard full-size Acme block occupy a space 8 by 8 by 16 in. in the wall, the same as most concrete block systems. The Acme system makes use of wet process molds.

Pyramid tile is a comparatively new product, providing a double air space feature in rather a novel manner. It is made by the poured process in steel molds. The normal sizes are 8 by 4 by 16 in., 8 by 8 by 16 in., and 8 by 12 by 16 in. in the wall.

The Eberling tile, well and favorably known for a number of years, has been quite extensively used in Detroit and Cleveland, and to some extent elsewhere. It is a rapid laying unit for all backing-up purposes. All of these units are easily interchangeable with brick where it is desirable to use the latter in conjunction with the former. Eberling load-bearing tile are made in the following sizes:

5 in. by 4 in. by 12 in.—weight 13 lbs.
5 in. by 8 in. by 12 in.—weight 27 lbs.
5 in. by 12 in. by 12 in.—weight 41 lbs.
5 in. by 17 in. by 12 in.—weight 55 lbs.

Eberling partition tile are made in the following sizes:

3 in. by 4 in. by 12 in.
3 in. by 8 in. by 12 in.
3 in. by 12 in. by 12 in.
3 in. by 17 in. by 12 in.
4 in. by 4 in. by 12 in.
4 in. by 8 in. by 12 in.
4 in. by 12 in. by 12 in.
4 in. by 17 in. by 12 in.
5 in. by 4 in. by 12 in.—weight 7 lbs.
5 in. by 8 in. by 12 in.—weight 15 lbs.
5 in. by 12 in. by 12 in.—weight 28 lbs.
5 in. by 17 in. by 12 in.—weight 39 lbs.
6 in. by 4 in. by 12 in.
6 in. by 8 in. by 12 in.
6 in. by 12 in. by 12 in.
6 in. by 17 in. by 12 in.

The first dimension given is the height as ordinarily laid in the wall.

Interior Surfaces of Concrete Walls

One of the practical hindrances encountered in concrete house construction today is the difficulty in attaching furring, finish and fixtures to the walls. Nails or screws cannot be driven through good concrete, nor can nails be driven into hardened portland cement mortar, as is customary with lime mortar.

The following methods are used to attach interior work to concrete block walls:

(1) Nailing or screwing into metal wall plugs or small wood strips inserted in the mortar joints at time of laying.

(2) Nailing or screwing into metal expansion plugs or wooden plugs driven into holes in the wall, the latter made with star drill or similar tool.

(3) Nailing by means of spikes or nails driven into the cement mortar of the joint before the latter has hardened completely.

The first of these three methods is the one generally

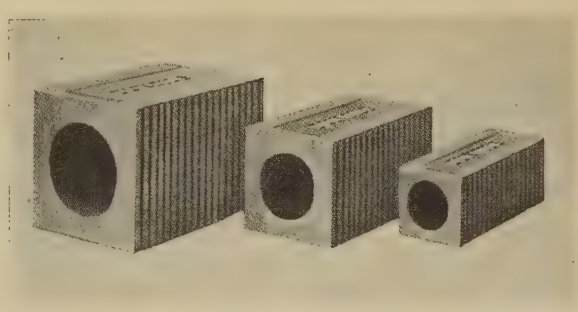


Fig. 64—The Three Normal Sizes of Duntile—8 by 8 by 12, 6 by 6 by 12, and 4 by 4 by 12—Two Parallel Sides Are Corrugated for Stucco and the Other Two Sides Are Slotted to Key the Mortar

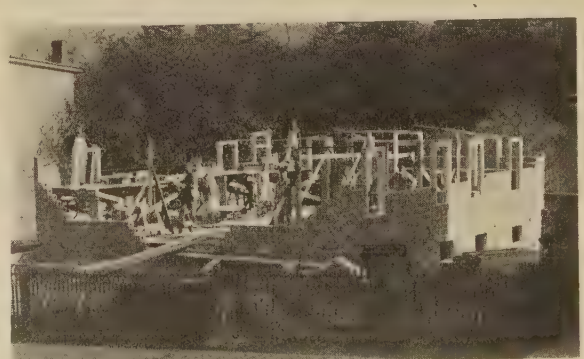


Fig. 65—6 by 6 by 12-in. Duntile Used in the Construction of a Small Dwelling at Pottsville, Pa.

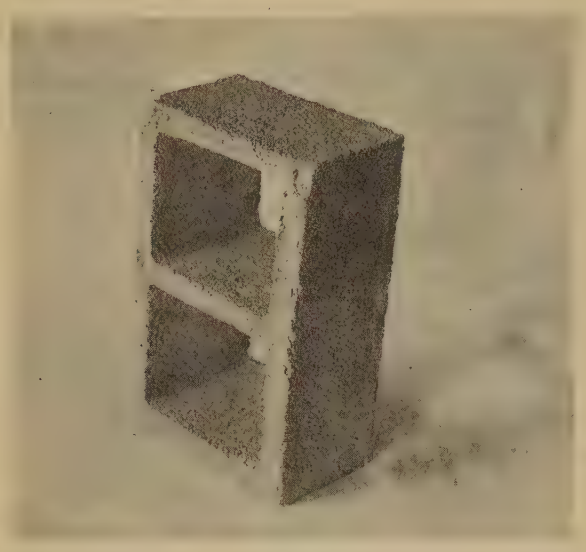


Fig. 66—Sample of the Ideal Wall Tile, 5 by 8 by 12 Inch Size—The Ideal Is the Latest Addition to the Concrete Building Tile Family

recommended as the most workmanlike and systematic. Metal plugs or nailing strips are made in several varieties, most of which are efficient and inexpensive. Wooden plugs may be made up from 1 in. width lath approximately 1 in. long, for anchoring furring, or longer as required for other purposes. The plugs or strips are laid in the mortar joints, flush with the inner surface.

Building the wall of concrete block 8 in. high, plugs or strips for the furring are placed in alternate horizontal joints, making them 16 in. apart, measuring vertically. They are spaced out according to the spacing of the furring, usually bringing the plugs 16 in. to 18 in. apart, measuring horizontally. With a ceiling height of about 8 ft., each furring strip has six points of attachment, which is ample. Where block 9 in. high are used,

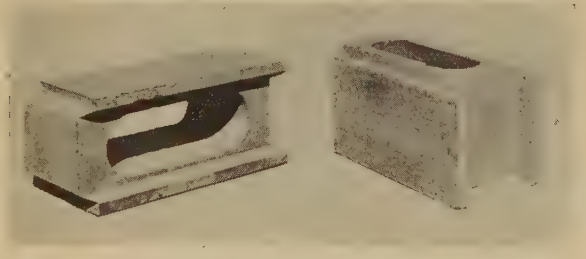


Fig. 67—Acme Interlocking Wall Tile, Showing the Grooved Surfaces by Which Each Tile Is Mechanically Keyed to All Surrounding Units

the strips are also placed in every other course, making the distance between fastenings in the furring 18 in., rather than 16 in., as noted above.

A great deal of time and labor is saved by the contractor who takes the trouble to accurately determine where he will need wall plugs and has them inserted accordingly.

The second method referred to is used where a plug is desired after the wall is completed. It involves less planning but much more labor than to place the plugs in the wall while building. The holes are produced with a star drill, a tool which may be described as similar to two blunt-edged cold chisels with cutting edges crossed. Holes made in this fashion may be from a quarter of an inch to an inch in diameter, but must be carefully made to avoid cracking, if made close to an edge or corner. A snug fitting plug is driven into the hole and the attachment made as customary when working in hardwood, drilling out any screw holes in advance.

The third method mentioned above cannot always be depended upon and, therefore, is not generally recommended. Carefully done, boards may be spiked to mortar joints while the latter are relatively soft, but the mortar is frequently displaced in so doing. It occasionally happens that the mortar joints become hard before attachments can be made as expected, and in such case attempts to drive through cement mortar are doomed to failure.

Wall Insulation

The concrete building industry is in need of definite information on the subject of wall insulation, for with the exception of a few fragmentary bits of evidence, we are without the definite essential facts.

It is safe to say that concrete block walls constructed of block of the rectangular or elliptical air space type, with thick webs and air spaces occupying approximately 33 per cent of the cross section area, should be furred and lathed on the inside before plastering, in the same manner as brick, tile and other masonry construction. In relatively dry moderate climates, experience has

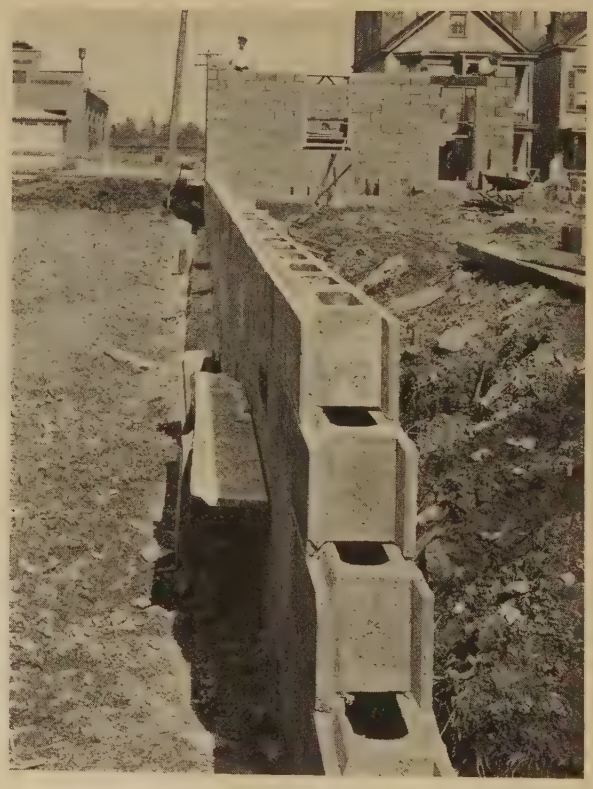


Fig. 68—Acme Tile in the Wall—The Units Are Made in Wet Molds and Are Particularly True to Shape

proven that plaster may safely be applied directly to such block. Whether or not furring and lath are absolutely necessary is very often a matter of local experience, and the best general advice that can be given is to use furring and lath wherever there is a doubt.

If block of the above types are made of good quality cinder aggregate, plaster may be applied direct to the inner surface of the block. provided that the outer surface is protected by an impervious facing at least three-

FIG. 69—PYRAMID TILE, A NEW AND RATHER UNIQUE UNIT, WITH TRIPLE BEARING SURFACES AND DOUBLE RIBBED AIR SPACES—IT IS PRODUCED BY THE WET MOLD METHOD

eighths of an inch thick or a covering of portland cement stucco.

Except under unusually favorable climatic conditions it is worth while to use furring and lathing with practically all of the concrete building tile systems. This is said in full appreciation of the fact that hundreds of satisfactory houses have been constructed with plaster placed directly on the concrete tile walls; it is also appreciated that concrete building tile will be found fully equal to the best clay tile in these regards, and that you can safely place concrete tile anywhere that clay tile have been satisfactorily used.

No furring or lathing is needed in the case of walls built of two-piece block systems having only small cross connectors, where units of good quality are used. In such cases, however, two-piece sills, lintels and special pieces must be used as well, or else the thickness of such specials should be diminished to 1½ less than the width of the block, in order to provide space for furring and lath backing for them.

[It is well for builders to consider that solid or partially solid masonry walls are not only inadvisable because of a fear of moisture penetration or interior condensation, but because of heat losses. This is important when the other factors cease to be important. A well insulated house is kept warm with a relatively small amount of fuel.—Editor.]

Armenian buildings of the sixth to the thirteenth centuries were built with walls composed of two faces of stone filled with concrete. The proportion of the thickness of the concrete to the facing material increased as the time approached the thirteenth century. The concrete is of very good quality, the bond between the concrete and the facing stone being very near unbreakable. —*Concrete and Constructional Engineering.*

Block Foundation Walls in Bridgeport

The Bridgeport, Conn., building code demands that concrete block foundations be constructed of solid block. This was disadvantageous to block construction, due to the difficulty of laying 12-in. solid block. Frank E. Clark, of the Bridgeport Stone Co., concrete block manufacturers, devised a wall of his own that is built up of a number of smaller units. The construction has been accepted by the building department.

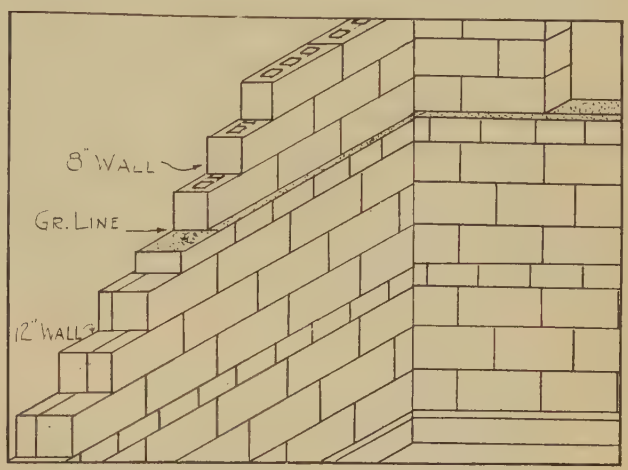


FIG. 1—PERSPECTIVE VIEW OF CLARK THREE-UNIT CONCRETE BLOCK FOUNDATION WALL

The wall is built up of 7½ in. by 8 in. by 16 in. and 3½ in. by 8 in. by 16 in. units, with 3½ in. by 8 in. by 12 in. units every third tier. The illustrations (Fig. 1) shows the construction and bond obtained.

The blocks are smooth surfaced and need no plaster or stucco covering.

Fig. 2 shows the method Mr. Clark uses in handling newly made block. He has 400 racks, holding 10,400 block—15 days' output—and Stuebing lift trucks. This enables him to leave the block alone for five days before handling, cutting down the breakage factor to a minimum.

FIG. 2—SHOWING BLOCK STORAGE RACKS

The Architects' Small House Service Bureau, Minneapolis, Minn., has begun the publication of a monthly magazine, *The Small House.* The first number, issued in March, stated that "the purpose of this bulletin is to supply the home builder with preliminary close-up information about costs, materials, home equipment and experiences of others who have used the service and the plans furnished by the Bureau."

Some Basic Problems of Products Makers

Marketing—Consistency—Aggregates—Curing

Having determined upon the plant layout and design of curing rooms, the problem of marketing can be studied. To concentrate on the problem concrete blocks or tile are discussed. There are a multitude of designs of block and tile, including every conceivable shape, division of air space and interlocking features. Of this assortment there are probably four ro five designs that are good and practicable in all respects. Elimination of the poor designs can be made by inspection and a final selection arrived at by investigation and tests. No doubt the information gained would result in further improvement. Such a study should, of course, be made on a basis of:

1. Building loads.
2. Fire resistance.
3. Conductivity.
4. Competition with other building materials.
5. Salability.
6. Acceptance by building trades.
7. Durability.
8. Appearance.
9. Economy in manufacturing cost.
10. Ease in handling or laying up on the job.
11. Strength to prevent breakage in handling.
12. Strength in wall.

With respect to consistency, there are two generally known methods of products manufacture—the dry and the wet. It is generally agreed that the dry consistency is below the consistency giving maximum strength, and the wet is above the consistency giving maximum strength. In the curing of the product some method or other may have considerable bearing on quality cost results. An investigation including these factors would no doubt enable us to arrive at a comparative economy of these methods.

The effect of the method of curing on products is an important subject on which there is little actually known. The consistency of the tamped or pressed concrete product is too dry. The questions that arise are: Is a warmed saturated air beneficial and is it an economical manufacturing operation? What temperature should prevail in the curing chamber for most economical production? To what extent are products improved or harmed by alternate wetting and drying, such as in sprinkling? What happens when products are subjected to various weather exposures and what practice should be followed?

It is generally agreed that with a continuous mixer one man's labor is saved, in comparison to a batch mixer, but is a continuous mixer dependable? Will it turn out as good concrete constantly as a batch mixer, and is it as economical?

In a products plant where comparatively dry consistencies are used and where in molding, maximum plasticity and uniform mixing is desirable, is it practicable to mix the concrete longer than one minute? It is hoped that these questions will be answered before the next convention of the Institute.

More exact data is needed on the performance of products making machinery from the standpoint of rate of production, quality, uniformity of product and mechanical troubles. Interesting data could be secured from products manufacturers who might co-operate to the extent of keeping a record along lines suggested by the Committee. Such a record, of course, should be kept over a considerable period of time to be of real value.

Plant Operation Practice

1. It is desirable to use materials which will produce the quality desired at the least cost for these materials. The cheapest price aggregate sometimes requires more cement and, therefore, results in a higher cost of the total materials than some other aggregate. Sometimes the choice of an inferior aggregate results in excessive breakage of product in manufacturing, thereby adding to its cost.

2. Aggregates should be selected with the best possible grading. Generally, the maximum sized aggregate should have a diameter of one-half the thickness of the thinnest wall of the product. As much coarse aggregate as possible, that is, those sizes larger than sand, should be used. Such aggregates do not require as much cement for equal strength concrete.

3. The water content of the concrete should be carefully established and kept constant. Tamped or pressed products should be made of concrete having as much water as can be used. In wet cast products, as little water as possible should be used.

4. After molding the product, it should be cured under conditions which will produce a uniform, satisfactory quality by the time the product is delivered to the purchaser, or at 28 days. Products should be kept at temperatures above 80° for at least 24 hrs. before placing them on the outside, where temperatures should not fall below 60°.

Products that are to be exposed to temperatures below 60° and above freezing, should be kept in a temperature above 80° for not less than 48 hrs. Where the outside temperature is expected to drop below 32° within 7 days, a longer period of curing should be used. It is believed that higher curing temperatures, say up to 125° F., produce better and quicker results. In hot, dry weather, products should be kept damp by sprinkling for about 7 days after they are taken from the curing rooms.

Products should be handled no more than absolutely necessary for the first 24 hrs. after they are molded. When they are handled, and especially directly after being taken from the machine, jarring is very apt to cause damage, especially to thin products that do not lay flat.

It is necessary, however, to remove products from the machine to a place for curing. This is usually accomplished by hand, carts, suspended conveyor, track and car system or trucks. The lift truck scheme is new and therefore, naturally there are those who object to it. It is believed that where it has been tried under proper conditions, it has proved successful and economical. It is advisable, however, to have a smooth floor kept reasonably clean. The truck should be of the type which lowers slowly and easily, and it should be equipped with rubber tires and have springs suitable for the load to be carried. Lift cars of narrow gauge are now being produced which eliminate the necessity of keeping the car itself in the curing chamber. In this manner, the life of the car is increased considerably.

[1]Excerpt from report of Committee P6, Products Plant Operation, American Concrete Institute Copyrighted Proceedings, Vol. 18, 1922.

The Trial of Eastern Cement Manufacturers: *Ends in Jury Disagreement*

By Edwin C. Eckel

Special Representative of "Concrete" at the Trial

Edwin C. Eckel, a Consulting Engineer in Washington, D. C., was engaged by Concrete to report the cement trial because of the belief that he was the best man to do the job with unswerving impartiality, and with the necessary background of knowledge of the cement manufacturing field. He was formerly with the U. S. Geological Survey; is the author of works of recognized standing on cement; during the war he had a great deal to do with the organization and equipment of cement plants in France for the United States forces and our allies on the Western Front. He is an Associate Member, Am. Society of Civil Engineers; member Society of Chemical Industry; Major, Engineers, U. S. R.

The trial of Eastern cement manufacturers ended in jury disagreement, and a new trial will probably begin promptly.

The proceedings were summarized in the May number of Concrete up to the close of the Government's case on May 4th. The present issue continues that summary, carrying the story through the case as presented for the defense, down to the end of the trial. In the July number of Concrete it will be possible to supplement the narrative by a brief statement as to the issues really involved in the case.

The Motion to Dismiss the Case

Following the close of the Government direct case May 4, attorneys for the defense presented several motions for dismissal, for elimination of testimony, etc. These were argued on May 5 and 8 by Messrs. Buckingham and Dorr for the defense and by Judge Fowler for the prosecution, in the absence of the jury. May 9 Judge Knox handed down his rulings on these motions. These included several points of minor importance—portions of the testimony of two witnesses were stricken out, and the Allentown Portland Cement Co. of New Jersey was eliminated from the case as being non-existent in fact.

On the main motions Judge Knox ruled as follows:

The first count of the indictment charges these defendants with having engaged in a conspiracy or a combination, the purpose of which was to restrain interstate commerce, and the evidence of the Government tends to show that that offense, if it became an offense, has continued over a period of years, down to the time of the filing of this indictment in 1921. I have therefore concluded to deny the defendants' motions to dismiss the first count of the indictment.

The second count of the indictment charges that the defendants entered into a *contract* to restrain commerce by restricting competition. If it be the fact that these defendants entered into a formal agreement, that contract was made more than three years prior to the filing of the indictment, namely, in 1916, and therefore it is barred by the statute of limitations. For that reason it devolves upon me at this time to direct the jury to return a verdict of not guilty as to each of the defendants upon the second count of the indictment.

The Beginning of the Defense

With these rulings, the defense commenced presentation of its case. At the outset Holger Struckmann, president of the International Cement Co., took the stand in order to explain to the jury two very striking sets of moving pictures, shown in the court room by the defense. The first series was of the Sierra Bayas plant of International, in Argentina; the second was of the Northampton mills of Atlas. Mr. Struckmann used the pictures as shown as texts for a very clear and complete description

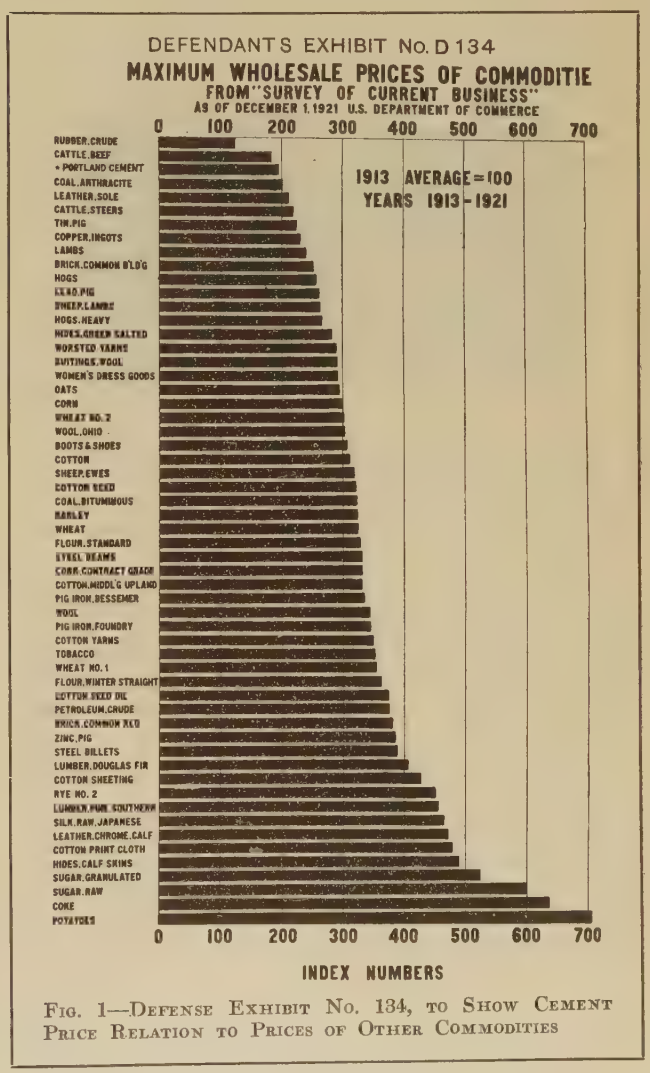


Fig. 1—Defense Exhibit No. 134, to Show Cement Price Relation to Prices of Other Commodities

of the various stages in the manufacture and handling of portland cement at modern mills, from the raw material quarries to the packing machinery.

The case for the defense was, as had been that for the Government, based largely upon statistical matter, shown both in tables and in charts or diagrams. The handling of these subjects by the defense was very markedly better, from a purely technical standpoint, than had been the stage management of the prosecu-

tion. When a mass of data were introduced, for example, which it was practically certain that no juryman could comprehend, the defense always had a striking diagram or chart available to bring out the points on which stress was desired.

Because of the character of the proofs offered, in summarizing the case for the defense I have so far as possible made use of the various exhibits which were placed in evidence on behalf of the defendants. The reader will understand that in reproducing such figures or diagrams here I am not in any way responsible for the accuracy of the figures, or for the deductions which the defense drew from them. They are presented exactly as sworn into the record by various witnesses for the defense.

Variations in Prices Received

The Government had charged, for example, that all the companies had maintained uniform prices, at any given period, as among themselves. In response to this the defense placed in evidence data which are best summarized in the chart, Fig. 2.

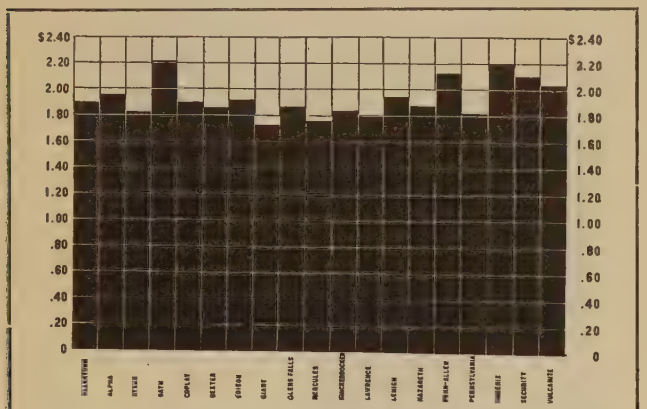


Fig. 2—Defense Exhibit 303—Varying Average Net Prices Received by 19 Companies for Barrel of Cement Year 1920

This chart shows the average net price actually received by each of the defendant companies throughout a typical year—1920 in the particular diagram which I have selected. Fig. 2 shows that in 1920 there was an actual variation of 50 cents per barrel between the average received by the most fortunate and the least fortunate of the defendant companies.

Increases in Manufacturing Costs and Prices

The Government charge that cement prices had been fixed at "arbitrary and excessive" levels was met by testimony as to the relative increase in the prices of cement, as compared with other commodities (Fig. 1); and also by testimony as to the actual increases of cost in cement manufacture during the war years and the brief period of post-war inflation.

The diagrams here presented as Figs. 3 and 4 are fairly representative of the character of the evidence introduced by the defense to cover this last point. It will be seen that in Fig. 3 the selling price of cement from 1913 to 1921, inclusive, is compared, as regards percentage of increase, with the average labor rates paid by the mills. In Fig. 4 a similar comparison is made between the selling price of cement and the cost of run-of-mine coal, per net ton at the mine.

The Valuation of the Cement Mills and Properties

As preliminary to contesting the Government claim that prices and profits were abnormally high, the defense

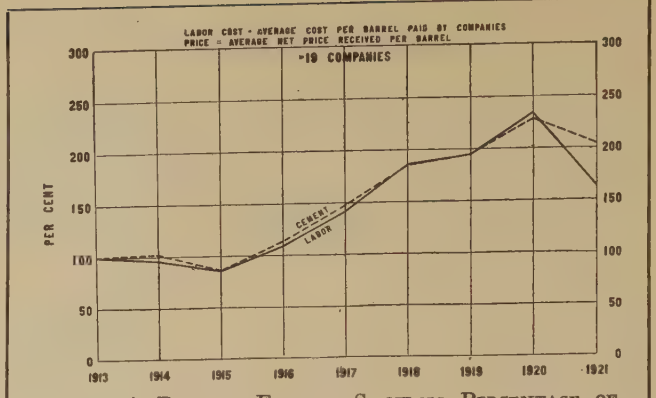


Fig. 3—A Defense Exhibit Showing Percentage of Increase in Labor Cost and Price of Cement Based on 1913

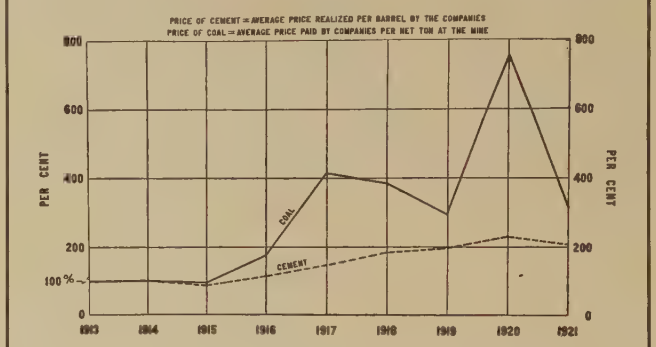


Fig. 4—Percentage of Increase in Price of Coal and Price of Cement (17 Companies) per Barrel, Based on 1913

introduced testimony by Richard K. Meade as to the value of the defendant company properties as of 1919. Mr. Meade placed the total valuation at a little over one hundred and fifty million dollars, that sum being made up as follows:

Valuation of mills	$117,771,960.00
Value of rock deposits	18,053,064.00
Working Capital	15,837,232.09
Total valuation	$151,662,256.09

Mr. Meade explained that the plant valuation was reached by assuming that in 1919 each barrel of annual capacity would have cost $3.79 in mill construction, reduced by 25% for depreciation; and that the rock deposits were valued at three-quarters of a cent per barrel producible.

The utility of these valuations in the present case is well brought out by Fig. 5, which establishes the rate of profit for the years 1919 and 1920, respectively, as being 3.3% and 2.0%.

Goethals, Hurley, and Adams

Three well known men testified in the second week in May for the defense, covering certain points of importance in the case.

May 10 General George Goethals took the stand for the defense. The General, after qualifying both as an engineer and as an industrial manager, described conditions as to bids for Government work at Panama from the very commencement of operations to the end of 1921. He stated that some eight million barrels in all had been used, that the bidding brought out often ten or more competitors at varying prices, and that at times twenty cents or more per barrel separated the lowest from the highest bids. Atlas took all the contracts successively against both American and foreign competitors.

Later General Goethals discussed competitive methods

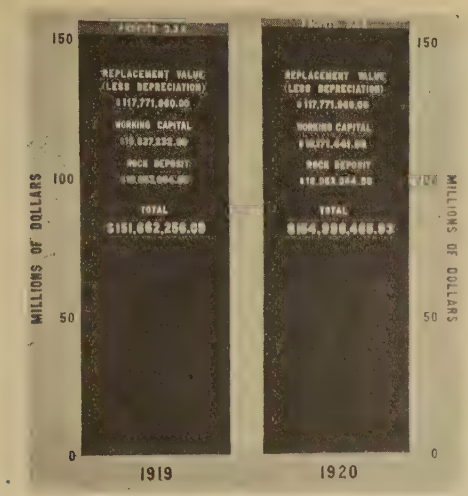


Fig. 5—Defense Exhibit Showing Profit on Cement in 1919 and 1920

and trade practices in various industries which he had carried on. The cross-examination consisted of only a few unimportant questions.

May 11 Edward N. Hurley, formerly (in succession) Chairman of the Federal Trade Commission, War Trade Board and Chairman Shipping Board, testified for the defense. Mr. Hurley was on the Federal Trade Commission at the time the Cement Makers' Protective Association started operations, and his testimony made it very clear that the Government, at that time (1915-1916), encouraged the formation of such trade associations and of this particular one directly. Mr. Hurley had gone over the plans for the C. M. P. A., and later advised the cement manufacturers to cooperate in gathering output statistics, in establishing a uniform cost accounting system, etc., etc. An interesting point was a statement he had made in July, 1916, to the manufacturers that the Attorney General had told him that the Government did not intend to bring criminal prosecutions against combinations formed in good faith, but whose later effects were harmful; but that in all such cases civil suits would be resorted to as affording an adequate means of undoing such evils.

Mr. Hurley later testified as to his own experience in trade practices, profits, etc., in various lines of manufacture. He stated that 15% average profit was needed by an industry in order to be properly prepared to meet bad periods when their "net should be in red."

May 12 Prof. Thomas Adams of Yale University took the stand for the defense. Prof. Adams qualified as an economist. Professor Adams testified that in any industry where the product was standardized, competition tended to bring about equality in prices. He said that this was the opinion of most economists, and quoted half a dozen. At this stage the defense offered in evidence ten or more books on the subject, which were ruled out by the court, to the manifest relief of the jury, which had too much reading at other stages of the trial.

Professor Adams then testified that the national banks of the country, over the last 45 years, had averaged 8.6% net profits annually; and that an industrial company should earn at least 12% on the average in order to keep going successfully through good and bad times.

Cross-examination did not seriously alter or shake his testimony.

Company Receipts and Expenses

Along the same line, but reasoning from different data, were the results exemplified in Figs. 6 and 7. These show the receipts and expenses of the defendant companies for each year from 1913 to 1921, inclusive. In Fig. 6 these receipts and expenses are stated in aggregate, in millions of dollars. In Fig. 7 they are divided by the number of barrels sold so as to be shown in dollars per barrel.

In each case the data used were stated to have been derived from the returns made by the individual companies to the Government in accounting for their income taxes for the respective years covered by the diagrams.

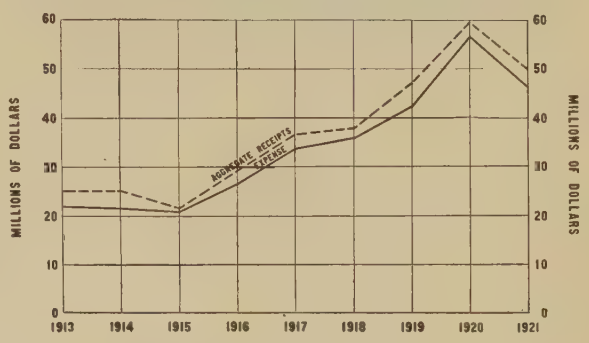


Fig. 6—Aggregate Receipts from Sale of Cement at Mills and Expense (19 Companies)

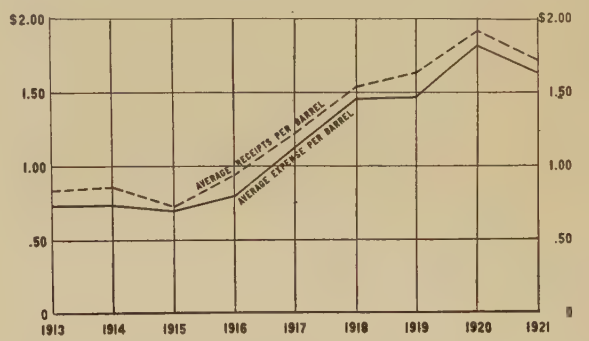


Fig. 7—Average Receipts per Barrel from Sale of Cement at Mills and Expense per Barrel (19 Companies)

Rate of Return of Invested Capital

Derived in similar fashion from income tax returns, the rate of return on amount of capital invested in the cement business is shown in Figs. 8 and 9, also placed in evidence by the defense. It is to be noted that the "invested capital" shown in these diagrams is not the 151 millions of the Meade estimate referred to earlier, but the amount—about half as large—reported by the companies in their transactions with the Government. Even on this basis the rate of return is shown to be very small for an industrial enterprise, ranging from a maximum of 6.7% in the most prosperous year of the period—1919—down to an average of 1.0% in the poorest year—1915.

These results are shown in two forms on the accompanying diagrams; in Fig. 8 the total invested capital and total net profits are shown in blocks; while in Fig. 9 the rate of return alone is shown, but in perhaps a clearer way.

Closing Witnesses and Arguments

Most of the data on income, expenses and profits introduced by the defense and summarized in preceding paragraphs was based upon the testimony of John P. Fernsler, accountant, while the comparisons regarding trade practices were placed in evidence by Mr. Jube. The closing witness for the defense was Major C. R. Hulsart, who has been vice-president of the Cement Manu-

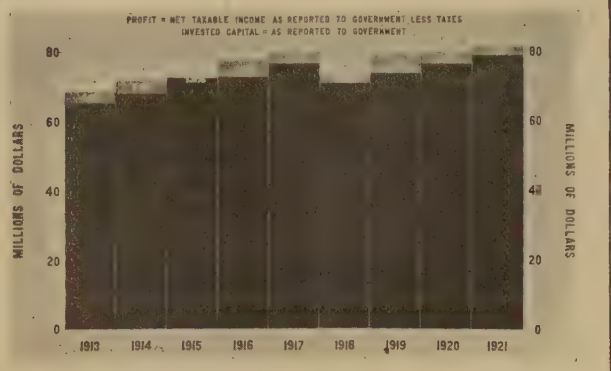


FIG. 8—PROFIT AND INVESTED CAPITAL—(19 COMPANIES)

facturers Protective Association since March, 1920, and who, in that capacity, has had direct charge of the activities of that association. Major Hulsart, aside from general testimony, placed in evidence two facts bearing directly upon the charge of the Government that the job-contract reports were used in some way as a basis for price fixing. One of these was his statement that, based on study of the actual records, over eight days on the average elapsed between the signature of these contracts and the date at which the information reaches the Association office. The second fact in relation to this matter was that in going over these job-contract reports he had found over eleven hundred instances in which there were differences in the prices made by different defendant companies on contracts in the same town and at the same time. Finally, a matter which goes to the root of the reporting system, Major Hulsart testified that during 1920 the Protective Association investigated 2,305 contracts, of which 1,392 were found to be "padded." The excess covered by these duplications or over-estimates amounted to over three and a half million barrels.

DEFENSE CLOSES

The defense closed its case late on May 18, and on May 19 the Government made a very brief case in rebuttal. The Court allowed each side six hours for its summing-up arguments. These occupied the days of May 23 and May 24. Roger Shale made the introductory summing up for the Government, being followed by Colonel Stimson for the defense, while Judge Fowler closed the argument for the Government. The three speeches were excellent summaries of the evidence in the case, as each speaker saw that evidence.

Yet, after eight weeks of trial, after ten thousand printed pages of testimony and exhibits had been produced, and after many lawyers had tried to clear up the case, the principal matters at issue were left in much of their original obscurity. The Government claimed that prices had been fixed by agreement, but it had offered no direct proof as to the agreement, and had propounded no real theory as to the mechanism employed in its operation. The defense claimed that prices were purely competitive, but it left some curious coincidences unexplained. The real issues tended to be obscured by the sheer mass of facts that had been placed in evidence—facts many of which were unimportant or irrelevant, and many of which were left unrelated, even after the summing up by defense and Government.

Fortunately for the interests of sanity, an intelligence of high order was to have the last word. In an address of little more than an hour Judge Knox cleared away most of the obscurities, and placed the leading features of the case in clear relief.

JUDGE KNOX CHARGES THE JURY

At 10:30 a. m., Thursday, May 25, Judge Knox charged the jury. The charge was relatively short; it was expressed with a clarity and definiteness which were welcome, and it was absolutely fair to both Government and defense. Three main features were emphasized: (1) the general bearing of the Sherman act, (2) the valuation to be placed on circumstantial evidence, and (3) specific applications of these and other matters on the present case.

A few literal citations from Judge Knox's charge will, I think, summarize its trend best in the limited space here available:

It is the Government's theory that the Cement Manufacturers Protective Association was but the consummation of previous agreements and organizations, which began as far back as 1902, and that the evidence of the conspiracy consists not only in the organization of the Protective Association, but

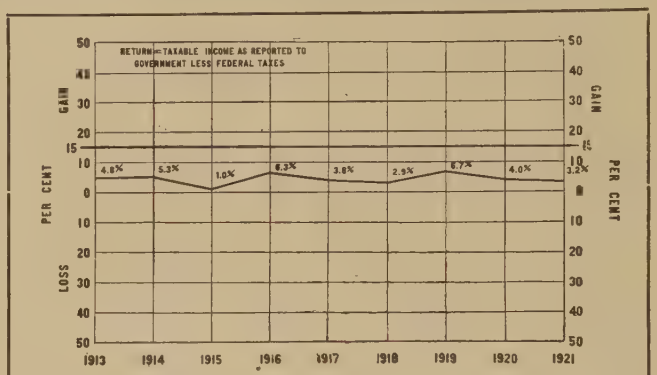


FIG. 9—PERCENTAGE OF RETURN ON INVESTED CAPITAL AS REPORTED TO GOVERNMENT

also in the numerous communications passing between defendants pursuant to the plan of said Association, and the other activities which resulted in the combination. The defendants say the evidence indicates a lively competition between the defendants—that is a matter for you to say.

As regards the criteria to be applied in determining whether or not an unreasonable restraint of trade had actually been accomplished, Judge Knox said:

The answer is to be found in looking at the cement trade as it was carried on by this group of manufacturers, the conditions that existed prior to the formation of any conspiracy or combination that you may find to exist, the condition that existed thereafter, the character of the competition that formerly characterized the conduct of the various companies, and that which now takes place, the course of prices, together with all other circumstances relevant and material to the state of competition. With these facts before you, you should inquire of yourselves: Have the courses and channels of the cement trade been so clogged, changed or diverted by that which the defendants have done, so as unreasonably to affect the public in its desire to procure cement upon terms and conditions which reflect honest and reasonable competition between those who produce cement?

The question of price of any given commodity is a most important one. With that in view I am going to ask you to consider if, over the period of time you may find any conspiracy or combination to have existed * * * the result was that the price of cement was substantially greater than it would have been but for such combination. Also, has the supply of cement been so regulated and controlled * * * that the public has been required to make unreasonable concessions as to price, terms and conditions that it would not have been required to make had no combination existed.

Individually these defendants may do many things which, if done collectively, would be unlawful. One mill, if acting from its own volition, may shut down entirely * * * What one mill does each of the other mills may separately do, even though the production of cement ceases altogether. One mill may ask for its product any price it sees fit; it may sell only to such persons as it wants for its customers, and may give and require such terms as it pleases. And, if through some fortuitous circumstance, all the mills should do the same thing

at the same time, so long as the concert of action was not the result of agreement or understanding, the law would not be violated.

The mere possession of power does not necessarily imply crime, unless the power be unlawfully used. However, if persons possessed of such power, through their joint activity, should exercise it simultaneously, it is quite likely to give rise to a suspicion that it is so exercised as a result of agreement, conspiracy or combination, and that the activities of the parties in exchanging information is only a means whereby the parties are equipped to carry out their agreement, conspiracy or combination.

That, as I have said, is what the Government charges against the defendants. Whether the charge is or is not made out depends upon the construction that you place upon the evidence. You can ask yourselves whether or not it is reasonable for persons so to position themselves and so to act, unless pursuant to an agreement. You have heard the evidence submitted by both sides; in argument you have had clearly presented the inferences and conclusions which opposing counsel desire that you should deduce from the evidence. I cannot amplify or make clearer the antagonistic position of the parties, and I shall not undertake the task.

The Jury Deliberates—and Disagrees

The Judge's charge was concluded before noon Thursday, May 25, and the case went to the jury. Hopes of a speedy decision disappeared as the jury continued its deliberations throughout the remainder of the day and evening. On Friday the jury asked that the Judge re-read to them two sections of his charge, and that two specific portions of the evidence be given them for examination.

The sections of Judge Knox's charge which the jury asked to have restated were those respectively dealing with (a) the bearings of the Sherman act and (b) the valuation to be placed on circumstantial evidence. The two pieces of evidence desired were (c) the Allen tables regarding output, etc., and (d) the forms used by the Cement Manufacturers Protective Association. Taken together, these requests suggested that something more than a minor disagreement was in progress, and that several distinct lines of thought were struggling for mastery in the jury room.

Case Will Be Retried

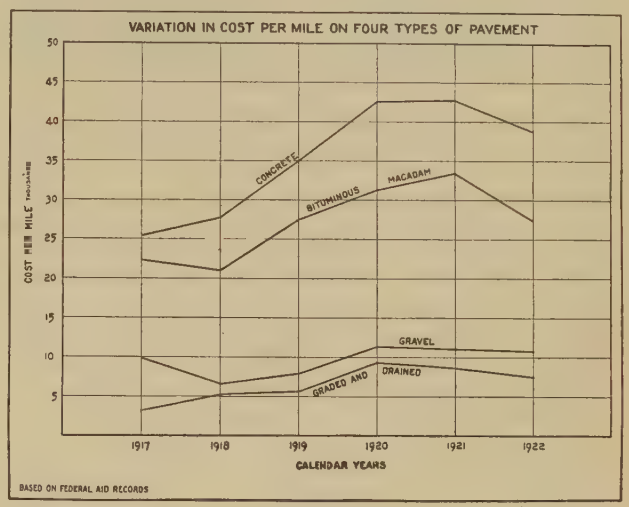
Late on Friday night the jury reported that agreement was impossible, and at 10:30 p. m. Judge Knox dismissed the jury. It is stated that the balloting for a verdict resulted in seven for acquittal and five for conviction. Judge Fowler, for the Government, announced that the case would be promptly retried.

In view of the character of the Government case, which was based almost entirely on circumstantial evidence, and of the further fact that the defense disproved many of the claims advanced, the result of the trial must be looked upon as being almost a victory for the Government. It is, however, not so much a tribute to the strength of the direct evidence brought out, as to the general atmosphere of hostility or suspicion with which the cement industry is at present surrounded. Regardless of the results of this and succeeding trials, the suspicions of the public in general and of the cement consumer in particular, must be removed before the industry can be looked on as being in a sound position. This subject will be recurred to later.

A Further Analysis of the Facts Developed by the Cement Trial will be Presented in CONCRETE for July.

Roads Built by Federal Aid Since 1916

The Bureau of Public Roads of the United States Department of Agriculture reports that on March 31 there had been completed since 1916 11,017 miles of Federal-aid road and gives the milage of each type and the average cost per mile. The figures are based on a large volume of work and are the most recent and reliable figures giving average costs for the whole of the United States. The figures cover the entire cost of construction, excluding large bridges and in a few cases the cost of engineering is not included.



These figures are based on the entire period of operation of Federal aid, but the major portion of the work has been done since 1918.

The accompanying chart shows the variation in cost per mile of four types of road since 1917. It is incorrect to assume that the rise in prices shown is due entirely to increased cost of labor and materials. During this period there was a general tendency to construct wider and more substantial roads to meet the needs of modern traffic.

Type	Cost Per Mile	Miles Constructed
Graded and drained	$9,200	1,752
Sand-clay	6,850	1,338
Gravel	9,230	4,389
Water-bound macadam	14,000	294
Bituminous macadam	25,720	382
Bituminous concrete	43,500	511
Concrete	36,600	2,104
Brick	46,875	224

Portland Cement Specifications Advance to American Standard

The "Specifications and Tests for Portland Cement," for which the American Society for Testing Materials is sponsor, have been advanced to the full status of "American Standard" by the American Engineering Standards Committee. These specifications, which have been developed as a result of the experience of the industry through several years, were first approved by the A. E. S. C. as "Tentative American Standard" in 1919. They were reapproved in 1921, after agreements had been reached which eliminated slight differences between the Government and the commercial specifications, resulting in nationally recognized uniform specifications.

Girderless Floors in Malmo, Sweden

Translation in Abstract from *Beton und Eisen*

By Willis A. Slater
Washington

Beton und Eisen, January 5, 1922, contains an article on flat slab ("mushroom floor") construction in a large building at Malmo, Sweden.

This article discusses briefly the basis for design, refers to the results of tests in America, and describes the design, construction and test of a flat slab building, 136 ft. by 393 ft., having panels approximately 16 ft. square and a design load of about 450 lbs. per sq. ft The total slab thickness was about 8¼ in.

On account of the prevailing high wages and high prices of lumber, the forms were made of sheet metal and as simple as possible. Round columns were used and these were of the same diameter for the two upper stories. The column forms were removed in from two to three days after concreting, in order to use them again. In order to simplify the form work, all marginal beams were avoided. The cement finish was applied simultaneously with the concreting, so that the floor was complete as soon as it had hardened.

It is stated that the slab was designed with a moment coefficient 20% greater than is required by the "latest American specifications." Presumably the New York building code requirement is here referred to, though the article cited in that connection gives a review in which six different American standards are quoted. From the sections of the slab and the amount of reinforcement shown in the drawings it would appear that the total positive moment was about $.031wl$ and the total negative moment was about $.046wl$. This is about 20% greater total bending moment than would be required by the New Joint Committee Specifications, but is about 33% greater than the New York code requirements.

The test load was applied to two wall panels separated by an unloaded interior panel, and was 50% greater than the design load. The greatest deflection was about ⅛ in. As a result of the test, it is concluded that it is evident that the bending moment assumed for the design was greater than would have been necessary. The working stresses used were approximately 17,000 lbs. per sq. in. for the steel stress and 650 lbs. per sq. in. for the concrete stress. The article states that in America 80% of all floors are built as flat slabs, but that unfortunately European designers had been hesitant in adopting them, principally on account of the imperfections of the early methods of design. It expresses the hope that the advantages of flat slabs may be more fully utilized and that experience and tests will lead to simple methods of design which are in harmony with practice.

In conclusion the article lists the following advantages of the flat slab which were realized in the design employed: (1) Simple and cheap forms, requiring for their placing only about one-half the labor usually required, (2) the possibility of using the form lumber more than once, because of the small amount of cutting, (3) a not inconsiderable saving in height of buildings of several stories, (4) good illumination on account of the absence of interfering beams, and (5) with proper design and construction a total cost of the floor which is less than with other construction, especially for heavy loads and uniform floor plans.

It is stated that in many cases, however, on account of unequal and long spans, and large and un-uniform openings, etc., a beam floor proves itself more advantageous than the flat slab.

A Concrete Soliloquy

By Provo Hamlet

To bond or not to bond! That is the question.
Whether it be more economical to suffer
The jars and wreckage of these outrageous roads,
Or to take steps against a world of mudholes
And by construction end them? To pave, to concrete
No more, and by a pavement to say we end
The tire rips and a thousand little garage bills
That bad roads give us. 'Tis a consummation
Devoutly to be wished. To pave, to improve.
To improve? Perchance to pay—aye, there's the rub;
For in bonding for improvement what taxes may come,
When we have passed this present depression
Now makes us pause. There's the bugaboo
That makes calamity of all our betterments.
For who bear the delays and loss of time,
The broken axles and twisted steering gear,
The cost of extra gasoline, to haul his loads—
The extra expense of so many kinds,
When he himself might curb it all
By voting bonds! Who would the fardels bear
To wade and wallow through ruts and bogs,
But that the dread of taxes yet to come—
Those moneys spent to cure our common ills
Which no man alone should have to pay—puzzle the will
And make us rather bear the roads we have
Than pay one-fourth the cost of concrete ones.
Thus false economy doth make cowards of us all.
And thus the work that might relieve this deadlock
Is set aside for the sake of a few cents on each thousand dollars,
And enterprise of great pith and moment
Regarding it, their currents turn awry, and lose the name of action.

The ordinary crusher dust which results from crushing stone can generally be used without any damage to the concrete. Fine screenings passing through a 100-mesh sieve would have no worse effect upon the concrete, it is believed, than would an equal volume of clay or other inert material. As most specifications allow clay to be present in fine aggregate to the extent of about 5%, the fine dust formed in crushing the stone, which is ordinarily less than this amount, is also permissable.

In 1915-1918 a large tunnel was built by the water works department of the city of Chicago, through which part of the city water supply is drawn. This tunnel was driven through solid limestone, and the stone which was blasted out of place was passed over a screen having 4-in. meshes. The material passing through the screen was carried directly to the mixer, where it was mixed with cement in suitable proportions and placed in the forms by means of a pneumatic mixer. The screenings were not removed from this stone, and according to the records of the Portland Cement Association an excellent quality of concrete resulted.

Examples are also now on record where crushed brick and crushed air-cooled slag from blast furnaces have been used very successfully without removing any of the screenings.

Grease Trap for Sewage Disposal Plant

By C. E. Parry
Chief Engineer Construction
Municipal Disposal Co., Philadelphia, Pa.

Shortly after placing the direct oxidation process sewage disposal plant at Phillipsburg, N. J., in active operation, it was found that a large quantity of oils and greases were delivered to the plant through the sewers, resulting from industrial wastes emptied into the sewers by various plants along their courses.

The greases and oils in question, although being thoroughly treated by the above process, were of such a nature that they gave a very unpleasing condition in the sedimentation basins, in the nature of a greasy film or coating over the entire contents of the basins. Several experiments were resorted to in trying to eliminate or catch the grease film, even to the use of baffle boards across the width of the basins; none of which were fully successful. A grease trap was designed and built to care for this nuisance at the plant.

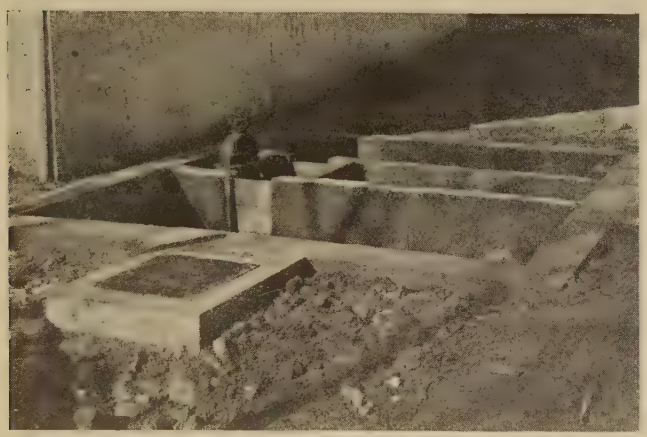


Fig. 1—View Showing Valve Pit for 6-in. Blow-Off Drain for Cleaning, with Plate Cover

The drawing (Fig. 1) shows the design in full, being a plan, elevation and section. Illustrations show the completed structure in operation, and also show greases collected, floating on the surface of the sewage.

The form work on this trap was rather complicated, owing to the fact that the plant could not be shut down, and the flow of sewage was continuous.

The 16-in. outlet pipe, starting from the valve shown on the left, Fig. 2, was first supported by timbers and slings, and the excavation was then made, sewage flowing through the pipe at the rate of approximately one and one-half million gallons per day. The footing, 46 in. square by 10 in. thick, was poured following the excavation, and reinforced with 3-9-25 steelcrete mesh. The side walls were then poured, leaving chases to receive the hopper floor. The 6-in. blow-off drain of wrought iron pipe was laid in place, also necessary chases to receive the flow duct, 34 in. by 29 in., all walls being reinforced with 3-9-25 steelcrete mesh. After concrete in all of the above structure had set for a period of 20 days, covered with tarpaulins, and heated with a coke salamander, having been poured in zero weather, the forms were removed and the concrete subjected to a thawing test.

Upon the 46 in. square footing was built the 34 in. by 34 in. tower flume, with four 12-in. by 18-in. openings

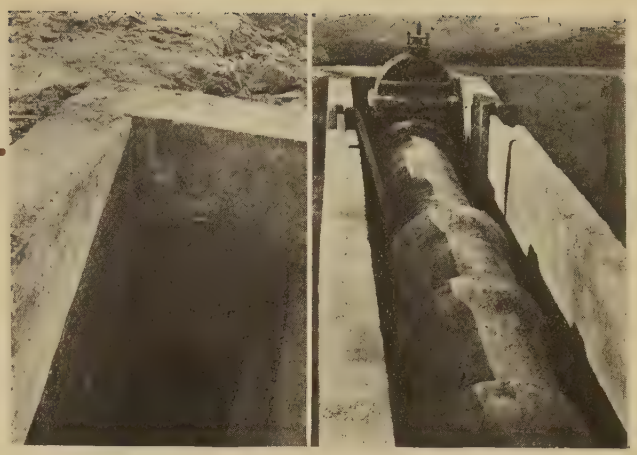
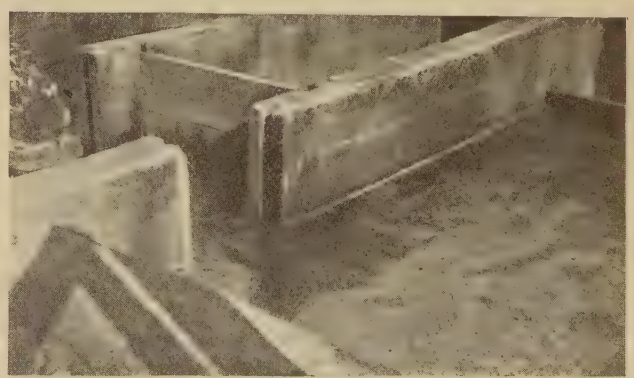


Fig. 2—(Left)—Wier Wall and Outlet to Coke Bed
Fig. 2—(Right) Showing 16-in. Pipe Before Breaking—In New Concrete Flume

at its base; also the 34-in. by 29-in. sewage flume with stop plank notches. These forms were built around the 16-in. pipe, which still served as a flow line to the sedimentation basins. Concrete was poured in these forms and reinforced with 3-9-25 steelcrete, allowed a 15-day set, covered with tarpaulins, and heated with a coke salamander. The forms having been removed, and concrete found satisfactory, the wier wall was built of hard burned brick with a concrete flume for run-off of greases. Stop planks were placed in the two sets of longitudinal slots, and the 18-in. pipe from the valve to the end wall of the trap was broken, and the pieces removed from the new flume, allowing the sewage to flow freely to the basins. The longitudinal planks were then removed and the cross planks placed in their slots, putting the trap into operation. The sewage flows along the longitudinal flume to the stop planks, whence it spills out of the side slots in the flume, passing to the main body of the trap basin. It flows in turn through



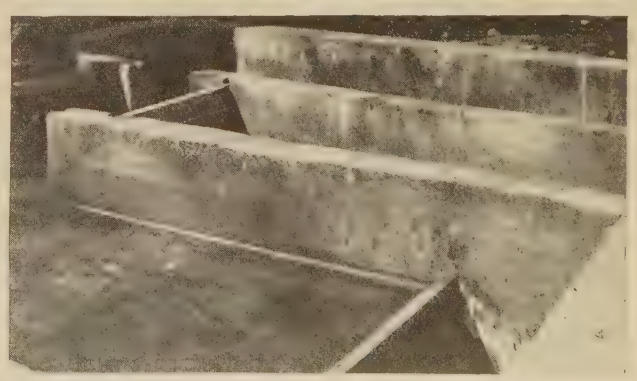


Fig. 3—Grease Accumulation on Sewage Before Passing Over Wier
Fig. 4—View Showing Grease, and Front of Wier Discharge

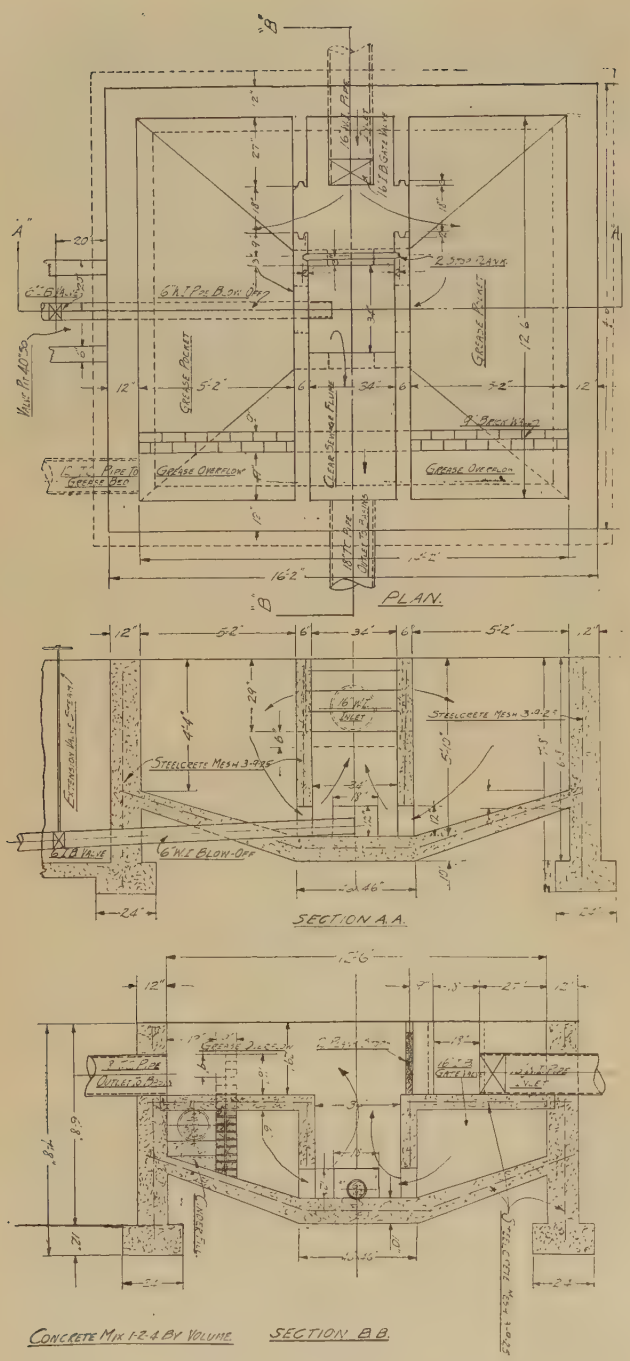


FIG. 5—PLAN AND SECTIONAL DETAILS, SHOWING INLET AND GREASE OVERFLOW

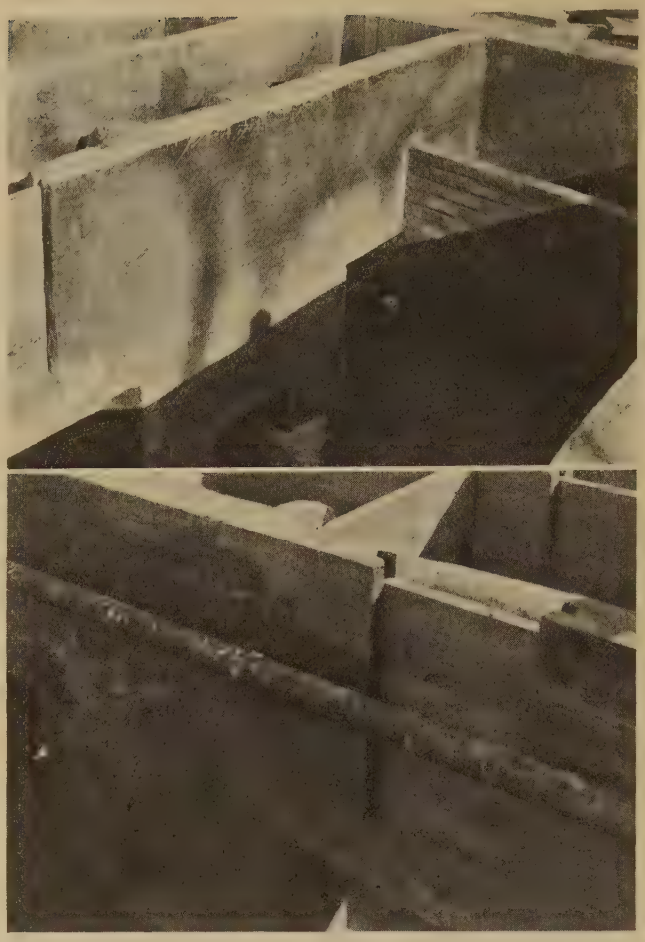


FIG. 6—GENERAL VIEW SHOWING COLUMN FLUME, LONGITUDINAL FLUME, WIER WALL AND 6-IN. BLOW-OFF

FIG. 7—VIEW SHOWING COLUMN FLUME WITH 12-IN. X 18-IN. ORIFICE AT BASE; ALSO STOP PLANKS BEFORE BREAKING PIPE

the 12-in. by 18-in. slots in the base of the column flume, thence upwards back to the longitudinal flume, and thence to the basin, the grease being collected on the surface of the sewage in the main basin, from three to four inches thick on the surface. The grease is skimmed or discharged automatically by closing shear gates on the sedimentation basin outlet, which raises the head in the trap and discharges the grease over the weir wall, where it passes to a coke bed. It is dewatered and retained, the water flowing to the creek, the grease being retained. When the coke becomes so saturated with grease that difficulty is encountered in dewatering, it is air-dried and used for fuel in the heating boiler, and a new coke filter made.

The concrete used in the above structure was all 1:2:4 mix, with ¾-in. aggregate and good clean sand. The steelcrete used was supplied by the Consolidated Expanded Metal Co., Braddock, Pa. The sub-contractors were Korp & Korp, Phillipsburg, N. J., and the city engineer permitting the work was Claire E. Tilton, Phillipsburg, N. J.

The writer had charge of the construction, and assisted in the design of the trap.

The performance of the trap has been all that could be asked for in efficiency, as approximately 85% to 90% of all grease flowing to it is collected and discharged to the coke beds, the sedimentation basins being at all times clear of the grease film so noticeable before putting the trap in operation.

Sound-Proof Construction

The demand for quiet rooms in hospitals, etc., as well as the desirability of insulating music studios and other rooms where disturbing sounds are produced, led to a series of experiments to determine the sound transmission of various building materials and methods of construction at the University of Illinois Experiment Station, and the incorporation of the data in Bulletin No. 127.

The results of this investigation indicate that a sound Proof partition should be as rigid and free from air passages as possible. For effectively sound-proofing a group of rooms, the partitions, floors and ceilings between adjacent rooms should be made continuous and rigid. Any necessary openings for pipes, ventilators, doors and windows should be placed in outside or corridor walls, where a leakage of sound is less objectionable.

The bulletin contains much detailed information concerning the details of sound-proof construction.

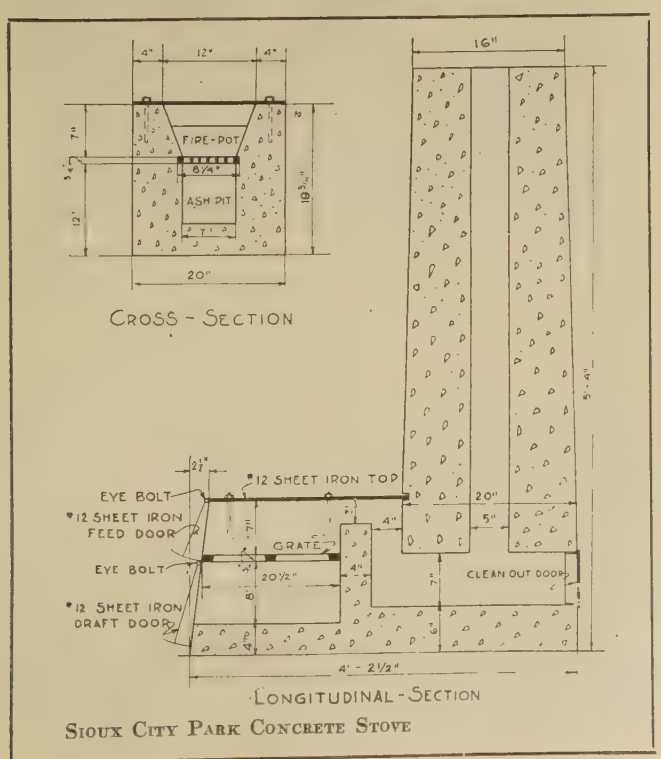
A Special Rig for Hauling Concrete Pipe

For hauling concrete pipe to be installed in a conduit system near Salt Lake City, a special rig was devised by the Engineering Department of Salt Lake City, Utah, Sylvester Q. Cannon, city engineer. The rig consisted of a two-wheel cart with a cradle body, hung low on gooseneck axles. Several of the rigs were used in transporting the pipe, made at a central casting plant, and the average haul for each outfit was from 14 to 17 miles a day. The pipe line was 17,100 ft. long, and laid at the rate of 275 to 300 ft. a day of eight hours. The pipe sections were 4 ft. long and 48 in. in diameter, and weighed 3,200 lbs. This type of rig made the hauling as well as the loading and unloading of the pipe an easy job.

Special Cart for Hauling Concrete Pipe

Park Stoves

The parks at Sioux City, Iowa are all supplied with concrete stoves as shown in the accompanying details. This gives the picnic parties a chance to roast "weenies" and make coffee without the usually attendant fire hazard. The stoves are made of concrete with a row of fire brick around the grate. The top is covered with sheet iron. In the front are two small, hinged sheet iron doors, the top one for the fire and the lower one for removing ashes. On account of the small space between the grate and the top of the stove only a small fire is needed to furnish sufficient heat for cooking. The smoke must pass over the concrete baffle before going out the chimney thus preventing sparks from flying out of the chimney.—*Concrete Builder.*



Sioux City Park Concrete Stove

How to Make Concrete Patches

Inquiry recently came to Concrete as to the use of lime water in cement mortar and concrete in making patches. Along this line Prof. Duff A. Abrams, Structural Materials Research Laboratory, Chicago, suggests:

"It seems quite apparent that the lime water would not do any harm, although I must confess that there is some doubt in my mind as to whether it does any real good in facilitating patching, or for any other reason. Our tests have shown that the addition of hydrated lime has a tendency to reduce the strength of concrete, although it would be expected that the small quantity of lime which would go into solution or remain in suspension in the mixing water would have a negligible effect on the strength of concrete.

"Our experience in patching concrete indicates that best results will be secured by the following procedure:

"1. Chipping off old concrete, exposing a new surface;

"2. Thoroughly clean surface;

"3. Saturate surface with water;

"4. Mix concrete or mortar same to stand for from 2 to 5 hours before it is put in place.

"With these precautions, any job of patching can be done with assurance of success. Allowing the concrete to stand for from 2 to 5 hours depends on weather conditions and seems to eliminate the initial shrinkage which is the cause of separation of new concrete from old in most cases."

Lindsley Block Tests

Following is a report of recent tests made on concrete block by C. E. Lindsley Co., Irvington, N. J. The tests were made at Watertown Arsenal. Mr. Lindsley is a strong believer in a standard product. While so far he has not had tests made at regular intervals, he proposes to do so, in spite of the fact that he has a supply of sand and slag which give him a uniform aggregate and has followed the same method of mixing, proportioning and curing in an endeavor to keep the standard uniform.

No. of Block	Area Under Compression	Gross Area of Block	Load	Net Area Lbs. per sq. in.	Gross Area Lbs. per sq. in.
1	142	189	289,000	2,035	1,524
2	142	189	312,000	2,200	1,650
3	142	189	295,000	2,100	1,570

Recent tests were made of the Lindsley block by the Structural Materials Research Laboratory on three samples. The block were 8 by 12 by 16, hollow, containing two vertical air spaces. Three specimens showed compressive strength over the gross area of 1320, 1450, and 1385 lbs., an average of 1385 lbs. and on the minimum or net area 1810, 1980 and 1900, an average of 1897 lbs. On absorption the three specimens tested 4.2, 5.5, and 4.9 per cent, an average of 4.9 per cent.

A Modern Dairy Barn

A concrete block barn, on Marlborough Farms, N. Y., owned by L. E. Doty, was recently awarded a prize as an ideal dairy barn, by the editors of the *Dairy Farmer*.

The walls are double and consist of two elements of concrete block tied together with metal strips across a 2-in. air space.

The milking room proper is 110 ft. long with stanchions for 52 cows. Between every two cows there is a

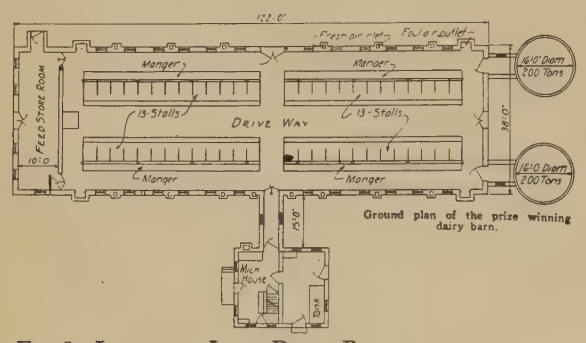


FIG. 1—LAYOUT OF IDEAL DAIRY BARN

drinking bowl supplied from springs. The room is ventilated with 24 openings, while a large flue leading to the peak carries off the foul air.

The floor is of reinforced concrete on metal lath. There is a 6 in. air space below the floor, with openings leading into the room, which adds to the warmth and dryness of the stable floor.

The hay loft, above the milking room, is supported by 12 steel girders. The floor is made of 1 in. matched flooring, and the girders are protected underneath by a covering of plaster on metal lath.

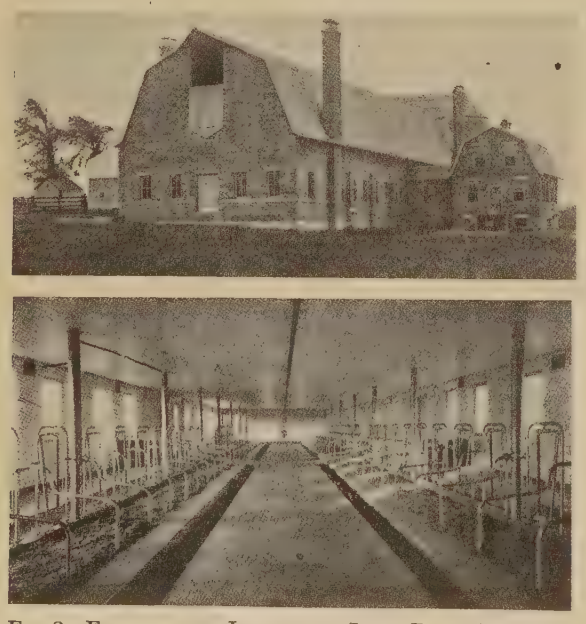


FIG. 2—EXTERIOR AND INTERIOR OF IDEAL DAIRY BARN

Attached to the south end are two silos with a capacity of 200 tons each. The manure track, carried on supports contrived out of old boiler tubes, runs between them.

The milk house is three stories high. The basement contains the steam engine and boiler. The second floor is divided into a wash room and a cooling room, while the third floor is used as an office.

An Unusually Neat Service Station

The picture shows the exceptionally neat and attractive automobile service station of El Camino Motor Service Co., Los Angeles, Cal., at Hollywood. The building is finished with a cement-stucco exterior, over frame

STUCCO SERVICE STATION IN HOLLYWOOD

construction; corners lined horizontally to produce a marble or dressed stone appearance, and the upper part of the walls effectively treated with panels and other ornamentation, while all windows and doorways are arched. The exterior color scheme is light French gray, with white trimming. The main building in front is a general service station and accessory store, and in the back is a long shed-like storage garage.

PERGOLA AND PORCH CONSTRUCTED WITH CONCRETE; MADE BY JULIUS RUOFF, PHILADELPHIA, PA.

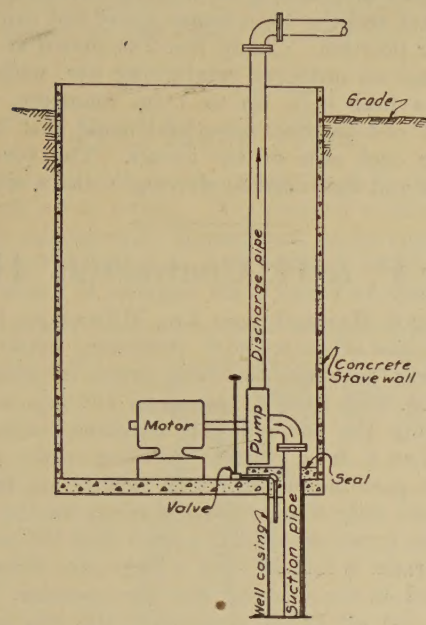
Porch and Pergola Work a Speciatly

The illustrations picture the use of ornamental concrete porch columns and other accessories made by Julius Ruoff of Philadelphia, Pa. The columns whether decorated with inlaid colored tile or raised ornamentation, present a unique and pleasing appearance.

Mica spar crystals, from dust to ¼ in. screen, together with a small part of trap rock screenings constitute the aggregate, which is mixed with cement in the proportion of 1:3. After the edges and seams are touched up, the column is washed with muriatic acid to secure a stone finish. This work never develops any hair cracks, Mr. Ruoff says. Attractive concrete garden furniture is made by using the same mix and procedure.

Concrete Stave Well Pits

The illustration pictures a typical concrete stave well pit, constructed by Guy G. Noble, Tulare, Cal. The ground water in this locality varies from a few feet below the surface to 60 ft. deep, which at times necessitates locating the pump some distance below the ground line. The soil varies, sand, silt, loam and clay all being encountered in digging a hole 20 ft. deep. These conditions all tend to make well sinking difficult, and when Mr. Noble thought of sinking a circular well pit made up of silo staves, he got a lot of business.



SECTIONAL VIEW OF WELL PIT

The first job, sinking a pit 8 ft. in diameter, 15 ft. through sand, was completed by two men in two days. After this well-sinking jobs were solicited just the same as silo jobs, and in three years Mr. Noble has sunk 200 well pits.

One pit, 5 ft. in diameter and 45 ft. deep, was sunk through sand, clay and loam. It has been in service three years and has had an outside water pressure equivalent to a 22 ft. head, but is apparently in as good a condition as when built. It has leaked a little at times, but this is taken care of by the drain pipe. The suction pipes of all wells are sealed with concrete and a ¾-in. pipe equipped with a valve is inserted through the seal to act as a drain.—*Concrete Builder.*

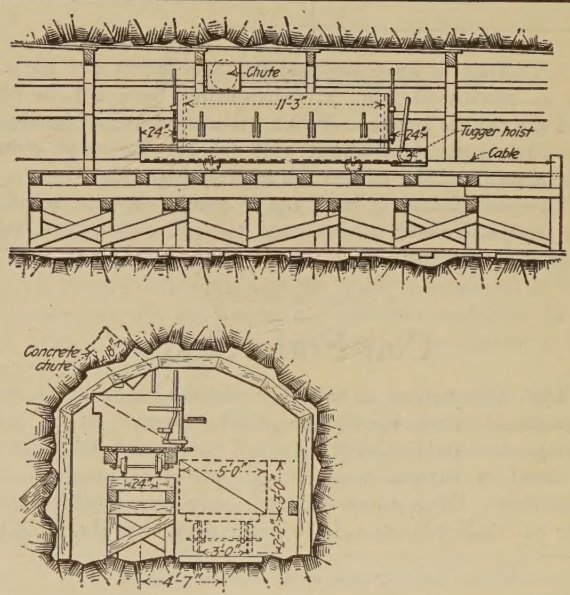
Water in a mixture of concrete is considered as having several functions. It reacts with the cement, making a binder which unites particles of sand and unites the sand with the stone or other coarse aggregate. Water of crystallization, which causes the cement to set, is supplied by the mixing water. Water is also considered to act as a flux to carry the binding material into the small surface irregularities in the particles of aggregate. It acts as a lubricant, making the flow of the mixed concrete into the forms or molds more readily accomplished. Another function of the mixing water is in occupying space in the mass.

Delivering Concrete to Pneumatic Gun on Tunnel Job

In delivering concrete to the pneumatic gun used for placing lining in the Kern Canyon tunnel, engineers of the San Joaquin Light & Power Corp. designed a movable hopper, which materially speeded up the work by making it unnecessary for the electric locomotive to spot cars accurately at the point where they were loaded. The hopper and cars were very similar in size and arrangement, both having six 11 cu. ft. compartments. The hopper, however, had only one gate; when this was tripped all compartments discharged simultaneously. The cars were provided with a separate gate for each compartment. The equipment is described in *Engineering News-Record.*

The motive power for the hopper was a small Tugger air hoist, mounted on the hopper body, and operating a cable wound several times around the drum of the hoist and deadened at both ends of the elevated track on which the hopper moved. A single Tugger served for operation in both directions.

The advantage of this arrangement was that the movable hopper could move along beneath the discharge end of the chute and thus get a uniform loading of all compartments. When the delivery car arrived on the track below, the hopper could be spotted quickly and accurately by an operator, who tripped the single door, filling all the compartments of the car. The car could then be taken into the tunnel and the 11-cu. ft. batches delivered, one at a time, to the gun.

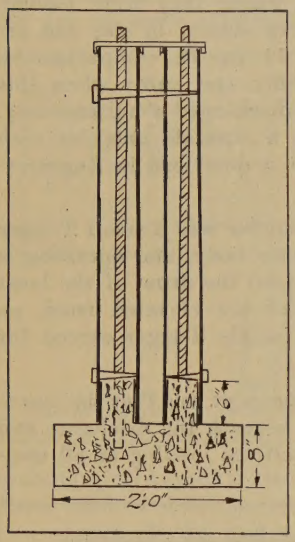


RELATION BETWEEN CHUTE, HOPPER, AND DELIVERY CAR

On a recent excavation job, where motor trucks had to haul the excavated rock out of a pit 80 ft. deep, wear and tear on the trucks and gas consumption was minimized by varying the grade of the incline. To climb out of the pit, the trucks ascended a short grade of 20%. This was followed for a short distance by a 12% grade, which levels out for 30 ft. to enable the driver to shift into second gear to make the final 250 ft. of 10% grade incline. This enabled the truck to make a fast climb.—*Successful Methods.*

M. & M. Hollow Wall

The M. & M. system of concrete hollow-wall construction[1], proposed for house, silo, bin and mine-shaft construction, makes use of steel forms, held by bolts and spacers. The form sections are made in three sizes, 4 by 6, 4 by 4, and 4 by 2 ft., and enable a 3 ft. 6 in. course to be poured with one setting.



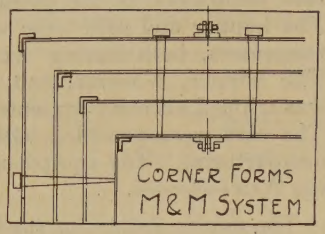


FIG. 1 — (LEFT) FORMS SET UP FOR FIRST COURSE
FIG. 2—(RIGHT) DETAIL OF CORNER FORMS

A footing is first poured and the forms are then set up as shown in Fig. 1, reinforcing bars set in place and the course poured. When this concrete has hardened, the forms are dismantled and set for the next course. The details of the corner forms are shown in Fig. 2.

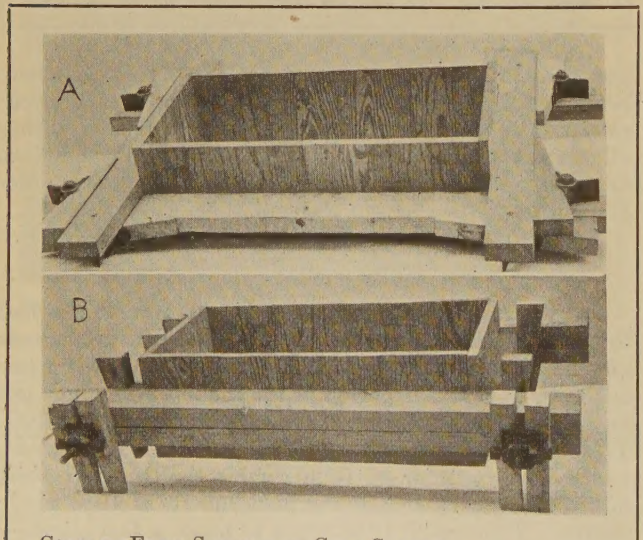
The roof frame is built up of steel I-beams, reinforcing bars and mesh placed, and the concrete is poured in plaster-board forms.

[1]Miess-McKay Building System, Inc., Salamanca, N. Y.

Colt Form Clamp

The illustration shows the method of using form clamps invented by Samuel Colt, Orange, N. J. The clamps are particularly adapted to form work, but can be used in various ways on all kinds of concrete construction. With these clamps, only one predetermined size of lumber is cut. It is pointed out by Mr. Colt that lumber used for the forms with these clamps has a high salvage value, as it is not appreciably harmed.

The method of using clamp No. 1 is shown at *A*, Fig. 1. The clamps are secured to a 2 by 4 or any other size lumber that is appropriate for the work in hand by a 5/8-in. lag screw. The form is then assembled and tightened by driving in the wedges, which are cut out of 2 by 4 with bevel of 2 in. in 10 in. The wedges can be secured by nailing, although this is not always necessary. When the form is to be stripped the wedges are knocked out and the form comes apart and can be moved to another position. Clamp No. 2 is shown at *B*, Fig. 1. In this case an ordinary reinforcing bar, with a forged head or a long bolt, up to 1 in. diameter, is passed through a slot in the timber and made fast by the set screws on each side of the clamp. The form is then assembled and tightened by driving in the wedges.



COLUMN FORM SECURED BY COLT CLAMPS

New P. & H. Contractors' Hoist

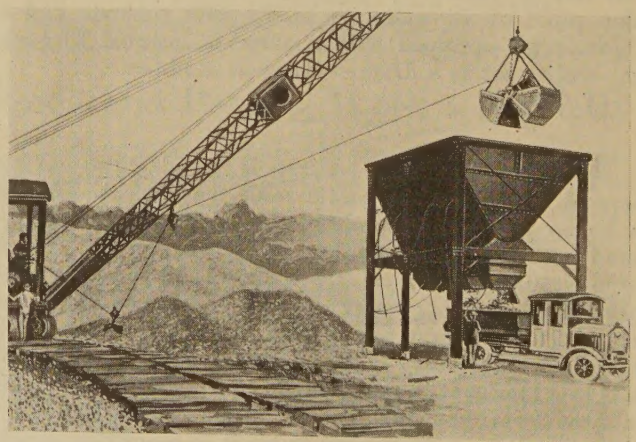
Pawling & Harnischfeger Co., Milwaukee, has standardized a line of contractors' stationary hoists, in types for electric, gasoline, and belt drive, in sizes ranging from 8 h.p. with 8x12 drum, up to 115 h.p. with 18x28 drum, using the same quality electrical apparatus as furnished on P. & H. electric traveling cranes and hoists.

For the gasoline-driven hoists, motors are in all cases of the heavy duty four cylinder vertical tractor type. The belt-driven types are similar except that the rear end of the bed frame is left off, and a large size driving pulley is provided on the side opposite the operator. The construction for all types is similar—the bed plates and side stands are of box and I-beam section design with heavy cross girders and bottom and top flanging. Plates are accurately planed and side-faced.

All-Steel Bins With Batch Measuring Gates

The Blaw-Knox Co. is making an all-steel storage bin which is lighter than a wooden bin of the same capacity. It can be dismantled and moved much easier than a wooden bin and with nothing to replace or rebuild at the end of the trip.

These bins are made of standard units which can be combined to give the contractor storage capacity of from 15 tons to 75 and 100 tons or larger if desired. They are of the correct height to obtain service from a portable crane and clamshell bucket and have sufficient clearance for any truck body on the market. An adjustable



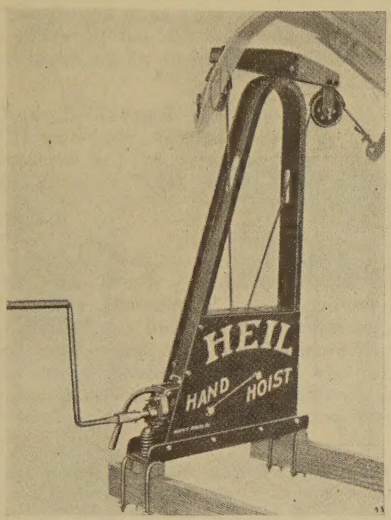
BLAW-KNOX STEEL BINS, ASSEMBLED ON THE JOB—HAS BATCH MEASURING GATES

measuring batcher is combined with these bins which provides the contractor with a measuring device made entirely of steel and located immediately beneath the bin. It also includes the bin gate.

When the storage bin gate is closed the material in the batcher is struck off at the same time. The right volume is then held suspended in the batcher. Only one workman is required to operate a 100-ton bin having four measuring hoppers of sand and four of stone. The batcher is adjustable. It can be supplied separately for attachment to any wood or steel bin in use at present.

Heil Hand Hoist

The illustration shows the Heil Hand Hoist designed to lift loads up to 5-tons. It is encased to keep out dirt and made substantially throughout, parts under special strain being fabricated of steel castings to give strength and lightness. It occupies but 8 inches of space and the



HEIL HAND HOIST FOR FIVE-TON LOADS

body can be placed right next to the Hoist because no extra space is needed for the body arms. The gear ratio is low and little effort is necessary to raise a loaded body. One minute to a minute and one-half is required to dump a load. The dumping angle varies from 35° to 40°, depending on length of the body. This hoist can be mounted on any chassis, weighs 290 lbs. and is furnished ready for installing with U bolts.

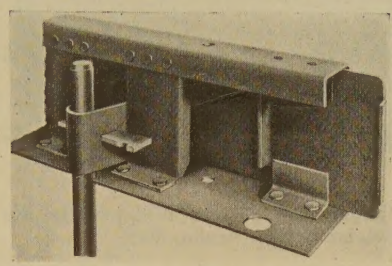
Pile Driver Attachment for Crane

To extend still further the application of P. & H. Excavator-cranes, a new pile-driving attachment has been developed by the Pawling & Harnischfeger Co. of Milwaukee. This can be used in place of the standard boom, the same as the shovel attachment and road-grading skimmer scoop. P. & H. machines have been used for pile-driving work before by contractors who rigged up their own pile-driving attachment. The new standardized attachment makes it possible to change over in short time with little trouble.

The construction consists of two offsetting brackets hinged on the sheave wheel-pin at the head of the boom, with horizontal bracing below. The weight of the hammer is 1964 pounds, and the follower 781 pounds. The entire machine can be moved from pile to pile by the same operator, since the attachment is made for use with either type of the full corduroy traction machine.

Blaw-Knox Road Forms

Recently announced improved C type Blaw-Knox steel road forms, made in 10 ft. sections, and with a staking system which locks the forms securely to the ground and holds them in line by hanging the form to the re-



THE NEWLY IMPROVED TYPE C BLAW KNOX ROAD FORM

movable stake with a heavy key or wedge. Five stiffening plates to support the top and bottom flanges as well as the vertical side; considerably heavier stakes; stronger and heavier wedges (pierced with a hole in one end so they can be fastened permanently in place); stronger slip-joint connection—all parts securely riveted; four additional auxiliary stake holes and heavier stake straps comprise the improvements.

Floor Hardeners

Announcement is made of Masif and Zimasif. The first is magnesium silico fluoride and the second magnesium and zinc silico fluoride. The use of these two chemicals is not at all new in the concrete field. It is only within the last year or two, however, that they have been offered generally to the contractor in original crystal form for him to add the water necessary to form a correct solution for hardening concrete surfaces. Masif and Zimasif are put on the market by Jungmann & Co., Inc., New York City.

For all ordinary work Masif is recommended for concrete, stucco and for floors of concrete. Zimasif is a little more expensive and is intended for use where floors or other surfaces are to be subjected to unusually severe wear. Masif is packed in barrels of 400 lbs.; Zimasif in kegs of 50 lbs. or boxes of 10 lbs.

New Stripper Block

A new stripper machine is offered by the Anchor Concrete Machinery Co. It is heavily built block equipment, and is turned out in three sizes, 16 in., 20 in., and 24 in., and makes any height of block up to 9 in. The 24 in. size will also make the Anchor high test building tile. The standard cores with this new stripper machine are made to match those in the Hobbs machine made by the same company. The feature of the blocks made on the new equipment is their large air space, the percentage running as high as fifty in the 12 in. wide blocks.

Automatic Block Machine Feeder

A semi-automatic feeding and finishing attachment for the Hobbs block machine is offered by the Anchor Concrete Machinery Co., with the idea of speeding up production and increasing the uniformity of the block. The attachment may be put on any Hobbs machine without any changes in the machine itself.

Organizations

American Concrete Institute; Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.

Associated Metal Lath Manufacturers, Edison Bldg., Chicago; Wharton Clay, Commissioner.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., Frank Whipperman, Secretary-Treasurer, 3045 Fowler Bldg., Omaha, Neb.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; E. Guy Sutton, Secretary, Williamsport, Ind.

The National Concrete Stave Silo Asociation; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

Trade Publications

Sometimes, but not often, a manufacturer's catalog is as attractive, informative, and as interesting to read as a good book. This is the case with "Built to Endure," an extraordinarily artistic and interesting booklet written by Philip Koehring and published by the Koehring Co., Milwaukee, Wis.

It is of 32 pages, 7 in. by 10 in., attractively bound in green boards and lettered in gold and blue; contains etchings in colors by William Mark Young of many notable examples of ancient and modern architecture and building remarkable for their age and enduring qualities, due to their being built, for the most part, of concrete. Side by side with each example of ancient work is a parallel case in modern construction; thus, the Acropolis of Athens and the Bush Terminal, New York; the Colosseum at Rome and the stadium of the New York "Yankees"; the Bridge over the Seine, Paris, and the Hell Gate Bridge, New York; the Pyramid of Cheops and the Black Hawk Monument, near Oregon, Ill.; all testify together to the time-defying quality of concrete.

The last few pages of the book are devoted to some recent important construction jobs on which Koehring mixers and equipment were used.

Heltzel Steel Forms—Catalog No. 28, Heltzel Steel Form & Iron Co., Warren, Ohio, 7½ in. by 10½ in., 22 pp. and cover. Illustrates and describes a line of steel road, sidewalk, curb and culvert forms, together with instructions for their proper use and maintenance.

The Austin Machinery Co., Chicago, Ill., has recently issued a 6 in. by 44 in. panoramic view in two colors of concrete road construction. The opposite side shows illustrations and brief descriptions of the Austin paver, mixer, tamper, subgrader, turntable, wagon loader ,gasoline locomotive, steam shovel, and drag line excavator.

Standardization in Concrete House Construction—Industrial Poured Concrete House Co., New York City; 7 in .by 10 in., 44 pp., bound in stiff boards, printed in two colors, illust. A booklet giving for the most part testimonials from people who have built houses according to the Lambie system, and pictures of concrete houses. Some details of the Lambie system are also included.

Handbook on Structural Waterproofing—Contract Waterproofing Co., St. Louis, Mo.; 8½ in. by 11 in., 24 pp. and cover, illust. This edition is written particularly for architects and contractors. It explains the system of waterproofing applied by this company, enumerates its advantages in comparison with other systems, and gives examples and proof of its satisfactory application. The edge of the book is provided with a handy tab marked "waterproofing," which makes it easy to find in a vertical file.

Logarithmic Slide Rule for Calculating Reinforced Concrete Structures—By J. Rieger, road and bridge engineer, professor at Polytechnic High School of Brno, Czechoslovakia. This is a 28-page pamphlet, 6 in. by 12 in., containing instructions for the use of the Rieger slide rule. The calculations of reinforced concrete structures are treated as divided into three groups: flexion, direct compression, and bending and direct stress. A scientific explanation of the method is given, and practical examples selected, beginning with the simplest and ending with the complicated forms.

The Ignition Temperature of Coal—By Ray W. Arms. Bulletin No. 128, Engineering Experiment Station, University of Illinois, Urbana, Ill. This is an illustrated booklet, 6 in. by 9 in., 70 pp., paper cover. The bulletin describes experiments to determine the ignition temperature of coal and illustrates the equipment and methods used, as well as a description of methods used by others. Results and discussions are given relative to various coals from different parts of the country.

Price Stationary Oil Engines—By the Ingersoll-Rand Co., 11 Broadway, New York. A 20-page booklet, 8½ in. by 11 in., paper covers, illust. This is descriptive of the horizontal, single-cylinder, four-stroke cycle, Type "PO" engine, giving dimensions of standard equipment.

Smith Pavers—By the T. L. Smith Co. This is a 32-page catalog, 7½ in. by 11 in., paper cover; illust. The latest information on Smith paving mixers is included, and among the new developments mentioned are the full caterpillar type traction machines, manufactured in the two larger sizes. Another feature that is brought out in the catalog is the small number of operating controls. One-man operation, it is claimed, has been made a practical reality.

Basic Specification for Tilework and Related Documents—First Edition, 1921, The Associated Tile Manufacturers, Beaver Falls, Pa., 7½ in. by 10½ in., 38 pp. and cover; price 25c; free to architects. This publication, just recently issued, is a compilation of basic specifications and special paragraphs covering the use of tile. The following specifications are covered: Tiles, Cements, Lime and Aggregates, Concrete and Mortar, Metal Lath, Shrinkage Mesh and Paper, Tile Setting, Tiled Floors, Tiled Walls, Tiled Ceilings, Swimming Pools, and Accessories.

One great convenience of these specifications is that work sheets are furnished in various colors, with or without covers, free of charge, for specification writers for use as scratch pages in preparing manuscript.

National Stucco-Plaster Fabric—National Steel Fabric Co., Pittsburgh, Pa. This new product for stucco and plaster, it is claimed, has equal reinforcing value in all directions, equalizes the stresses in the stucco slabs, thereby prevents cracking, and is self-furring, and develops a tensile strength of more than 60,000 lbs. per sq. in. of steel. It is furnished in 2 in. by 2 in., 2 in by 4 in., in both 12 and 14 gauge wires, and weights of 3.5, 2, 2.6, and 1.5 lbs. sq. yd.

Oil Burning Appliances—Aeroil Burner Co., Inc., 266 Hudson avenue, Union Hill, New Jersey. The equipment which this company puts out includes heaters for use in connection with concrete mixers in heating mixed concrete for cold weather work.

The Cement Gun—The Cement Gun Construction Co., Chicago and Pittsburgh, has recently issued a 32-page, 9 in. by 6 in. booklet, containing excellent pictures of work completed recently with the aid of the Cement Gun.

"One Hour and Fifty-seven Minutes" is the title of a publication by the Koehring Machine Co., telling an interesting story of mixer performance as reported by a concrete road engineer in Pennsylvania.